BASIC TECHNIQUES OF BLACKSMITHING:

A Manual for Trainers

by

The Farallones Institute Rural Center and CHP International, Inc

in collaboration with

the Peace Corps Energy Project/OPTC

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PREFACE

This training manual represents one component of a pilot training program in Blacksmithing/Agricultural Tools undertaken by the Farallones Institute and CHP International, Inc. It has been completed in accordance with the terms of Peace Corps Contract #282-1003.

We believe that our involvement has produced a valuable and adaptable learning tool. However, the manual must continue to be tested, evaluated, and modified in order to reflect changing needs and circumstances. It is our hope that you will contribute to that process, and that you will help make the manual more appropriate and useful during future training programs.

If you have observations or suggestions about the contents, methods, or approach included in the manual, please contact the authors at the Farallones Institute or CHP International, Inc.

ACKNOWLEDGMENTS

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We also thank the many kind people who have contributed by giving us permission to use materials they have developed.

Special thanks are extended to the members of the Farallones community for their continued support, endurance, and patience during the evolution of this project.

Finally, perhaps our most important acknowledgment should go to the Peace Corps trainees who have come to learn and, in turn, to teach. It is with them that we have shared our dreams and values. We hope that the tools and techniques they have chosen will serve the world kindly and well.

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INTRODUCTION

This manual is a guide for trainers who are helping Peace Corps Volunteers to acquire basic blacksmithing skills. The training is designed to give Volunteers a knowledge of metals and metalworking that will help them support rural communities in their efforts to produce tools for agriculture and cottage industry.

An equally important goal of Basic Techniques of Blacksmithing is to equip training participants with the skills and knowledge which will help them foster the community development process. Community development is a process that begins when people take an active role in their own education. It is a creative process, challenging members of a group to use their combined talents, resources and ingenuity to identify needs and find appropriate, sustainable ways to meet them. Trainers can contribute to this process by helping others learn from, support and build upon existing blacksmithing technologies. They can help by making training a model of the activity which constitutes community development.

Throughout the training, workshop participants are encouraged to take a full and active role in their own education, and to make decisions that will affect them and the people with whom they work and live. They are urged to cooperate with others, and to identify and use the talents and resources available within the group; they practice skills that help motivate people, instill within them a sense of self-confidence, and involve them in the process of their own education. The emphasis placed on developing and reinforcing these skills reflects Peace Corps' belief that technical expertise is valuable only when it is applied in balance with other qualities.

This approach to training is based on the principles of non-formal education, and is designed to strike a balance between structured learning and independent discovery. By using the sessions, resource and methods suggested in this program, trainers will provide Volunteers with a working knowledge of blacksmithing, as well as skills for developing that knowledge in a meaningful way.

The program offers training in the development of skills and techniques related to basic blacksmithing, including an attempt to familiarize Peace Corps Volunteers with the capabilities of existing local forges in the production of appropriate agricultural tools. The tool designs and skills are selected to be as consistent as possible with the realities of rural areas in developing countries.

The program is divided into twenty sessions which occur over a six-day period. Each session consists of a series of activities designed to meet specific training objectives. The objectives of each session are interrelated with fundamental themes which illustrate the connection and interdependence between technology and other aspects of community development. The program themes are:

* Development and Transfer of Technical Competence
* Principles and Techniques of Non-Formal Education and Adult Learning
* Methods and Approaches to Problem-Solving
* Development Issues
* Cross-Cultural Perspectives
* The Process of Assessment and Evaluation

The manual is designed to be responsive to a variety of training situations. Modification and adaptation of the materials is encouraged. However, it is essential to the effectiveness of the training to maintain the integrated nature of the sessions by providing an adequate balance of emphasis among the various themes. This will enable participants to build upon and apply new knowledge in a way that is ordered and meaningful within the context of community development.

The following guidelines have been developed as an aid in transforming this manual into an effective, dynamic training program:

Planning and Preparation

There are many steps that need to occur before the training actually begins. These include defining the scope and approach of the training, identifying staff requirements, locating and establishing a site, and gathering necessary resources and materials.

* Defining the scope and approach of the training:

  Sessions are designed to accomodate a maximum of twelve participants. If there are more than twelve, some modification of the design of activities will have to occur. The participants should be individuals whose current work in agriculture, rural or community development, or vocational education could be enhanced by a knowledge of basic blacksmithing techniques.

  Since blacksmithing involves mastering and becoming comfortable with a core of basic concepts and techniques through repeated practice and honing of skills, this manual is designed to provide participants with exposure to and practice in those basic concepts. The first technical session is designed to provide an overview of the major concepts involved and lay the groundwork for the remainder of the program. Each succeedin session requires the use of skills practiced in prior sessions and introduces one to three new techniques. In this manner, it is intended that participants will complete the program with sufficient skills to enable them to understand and maximize the capabilities of local forges in the production of simple agricultural tools; to set up their own small forge facility; and to continue practicing their blacksmithing skills by adapting and modifying them to suit the needs of the communities in which they are working.

* Identifying staff and trainers:

The specific number of staff should depend on the particular training situation. As a minimal requirement, there should be at least one primary technical trainer and one training coordinator for each twelve participants. The primary technical trainer should be an experienced, capable blacksmith with experience working in developing countries. He/she should have skill in making many types of hand tools using available scrap steel and should be comfortable with the principles of non-formal education, adult learning and integrated training. The training coordinator should have a working knowledge of blacksmithing and experience delivering integrated, participatory training programs. He/she should take the primary role in logistical coordination, facilitation, and helping participants assess their progress and evaluate the program.

It would also be beneficial to have an assistant technical trainer that is a native of the country in which the training is being held. The assistant should be an experienced local blacksmith who has had some prior experience working in cross-cultural situations.

* Locating and establishing a site:

The training program should be located in or near an area that has some ongoing metal work activity, and in a place where a supply of scrap steel is available. It should be in a center of commerce where materials can be purchased and transported easily. It is best to choose a site that includes adequate space to set up six or seven working forges. The training should be held in or near an area where local blacksmiths are working. The rental of space in an existing blacksmith shop, vocational school or outbuilding would be ideal.

* Gathering necessary resources and materials:

In order for participants to have the opportunity to practice basic blacksmithing skills, it will be necessary to set up a minimum of six (preferably seven) complete forge stations. Ideally, this will require approximately:

7 forges and bellows or blowers
5 anvils and stands or stumps
1 swage block (or equivalent)
3 mounted vices
3 grinders (motorized, electrical if possible)
7 (1,500 gr.) 3-lb. cross-or straight-peen hammers
7 (2,000 gr.) 4-lb. cross-or straight-peen hammers
7 10-lb. cross-or straight-peen hammers
7 pairs large vice grips
7 pairs flat tongs
7 prs. round or V-nose tongs (1/2" - 5/8")
7 prs. pick-up tongs (3/8")
7 hot cuts
7 cold cuts
3 hack saws with 6 extra blades (18 teeth per inch)
7 5-gal. quench buckets
3 quench buckets + lids (filled with recycled motor oil)
7 pieces of abrasive stone (e.g., carborundum)

For the most part, the exact amount of materials necessary will vary with each training situation. Be certain that ther are enough materials available before the program begins. It is estimated that there should be on hand approximately:

- 7 files
- fuel to supply forges for five days
- 4 hand-held wire brushes
- supply of flux and brass
- variety of leaf springs
- assorted coil springs
- 60' of ½" round bar or rebar
- 40' of 3/8" round bar or rebar
- 50' of 5/8" round bar or rebar
- a collection of miscellaneous scrap steel
- several axles
- bricks

It can be expected that many of the tools and much of the equipment needed for this program will be difficult to obtair in the country where the training is being held. In order t ensure that sufficient resources be available, it is recommer that the trainers bring some of the equipment with them and they arrive at least two weeks before the training is schedu to begin. They should make every effort to acquire locally available items, using as guides the materials and equipment lists included here. If some of the suggested items are not available or are not appropriate for use by local blacksmith. ingenuity should be used to find comparable substitutes.

Although they are not essential to the implementation of the program, a copy of one or both of the following books should be distributed to each participant as texts:

<u>The Modern Blacksmith</u>, by Alexander Weygers

<u>Edge of the Anvil: A Resource Book for the Blacksmith</u>, by Jack Andrews

Conducting the Training

Included here is a list of some considerations that are essential to remember in carrying out the program.

* <u>The training program is designed to provide the basic skills necessary to support local blacksmiths</u>:

Blacksmithing is a centuries-old craft, technology and livelihood. As farming and rural industries develop, the r of the blacksmith in community life takes on its significan Families need hoes, axes, and machetes. The carpenter, mas and leathermaker all demand specialized tools. Farmers wit draft animals ask for plows, cultivators, and hardware for their yokes and harnesses. For the blacksmith in developin countries, the production of these tools and implements inv many complex difficulties, including standardization of equ ment, uncontrolled marketing, scarcity of spare parts, shor of raw materials, and the unavailability of technical infor and educational opportunities for refining skills. This pr has been designed to provide participants with the basic kn ledge and skills necessary to help local blacksmiths work t overcome these difficulties.

* Blacksmithing is a skill which requires much practice to develop

Although it is explicitly brought out in several sessions, the trainer should continually stress that it is virtually impossib to emerge from a six-day training program as an expert blacksmith.

Blacksmithing is a craft which requires years of hard work, practice, and dedication to develop. Participants should realize that in many cultures, the exclusiveness of the craft has created a mysterious aura of awe and supersition around the metal-working trades.

* Safety precautions cannot be over-stressed:

In a blacksmith shop, the opportunity for serious injury is limitless. Extreme care should be taken throughout the progran to stress the importance of taking necessary safety precaution: A good general rule is that all metal should be considered too hot to touch until proven otherwise. Potential hazards can be compounded in an environment in which many inexperienced individuals are working in close proximity.

* Working in teams has multiple objectives:

During the program, participants will work in teams at forge stations. This enables them to help one another with many of the practices which require strenuous activity and/or more than one pair of hands. It insures that each participant will have ample opportunity to practice each of the basic technique demonstrated. And, it provides a forum for practicing the kinds of communication skills necessary to transfer skills to others.

* Most basic blacksmithing skills can only be acquired through careful observation followed by supervised practice:

In each of the sessions which call for a demonstration of a particular technique, every effort should be made to ensure that participants thoroughly understand the concepts and procedures involved. Write essential procedures on newsprint whenever necessary. Make demonstrations as clear as possible by explaining each procedure carefully and repeating whenever necessary. Following demonstrations, ask participants to review the procedures and to clarify any doubts or confusions which may exist.

* Flexibility, endurance, and patience are key requirements for blacksmithing:

The participants should be advised of the likelihood of spending long, strenuous hours tending their forges and practicing their skills. Blacksmithing does not lend itself well to structured, specified blocks of time. The times suggested to complete each session are approximations. Participants may complete some activities early whi[illegible] overtime on others.

* The experiential learning cycle is an essential part of trainir

  It is important that people have the opportunity to learn, examine, generalize about and apply new knowledge. Try to follow the experiential learning loop as often as possible, and encourage the participants to be aware of the process.

* Scheduled breaks between sessions are essential:

  Although 10 to 15 minutes is suggested, more time may be neede depending on the training circumstances.

Using the Manual

One of the keys to the success of the training program lies in thoroughly understanding and effectively using the manual. Include below are some guidelines and explanations designed to help in usin the manual.

* The Program Calendar indicates the overall design of the progr and recommended sequence of sessions. Use it as a reference f developing a specific schedule which meets the needs of the particular training situation.

* Sessions follow a consistent format. (See the "Sample Sessior Format" on Page vii for a detailed description.) Be certain tc read sessions thoroughly. There are often several purposes tc each session; for example, the activities may be designed to meet a technical objective, and at the same time, provide participants with practice in group problem-solving or communicat skills. It is important to understand the multi-tiered desigr of each session before presenting it.

* Attachments follow each session and are usually intended for distribution to the participants. Each attachment is letter-coded as to the session with which it is associated. It is important to make copies of attachments in advance so that the can be distributed during the session.

* The Bibliography includes the reference material, texts, and suggested resources used in developing this program. It can be copied and distributed to participants as the basis for further research in blacksmithing.

SAMPLE SESSION FORMAT

Title indicates subject area being presented.

Each session is numbered sequentially and coded by day.

Total Time gives approximate time needed to carry out the session.

Objectives tell what is expected of participants and what the session should accomplish.

Resources include all attachments and other suggested references.

Materials refers to suggested supplies and tools needed for the session. For some sessions, special tools are listed to provide focus and emphasis.

Procedures consist of steps to be followed in order to meet objectives. Each step is given an approximate time.

Session 4, ...

FORGE INTRODUCTION

Total Time: 4 hours

Objectives:

* To identify and define the basic components a forge
* To practice using basic blacksmithing tools
* To light, maintain and shut down a forge fi
* To make a forge poker/rake and eye
* To discuss forging practices of local black

Resources:

* Attachment 4-A,"Color/Heat Chart"
* Attachment 4-B,"Traditional and Rural Forge
* Andrews, pages 17-21 and 42-46
* Weygers, pages 20-23 and 94-96

Materials: Approximately 30-36 feet of ½ inch mild steel bar, newsprint, and felt-tip pens

Trainer Notes

Preparation for this session will involve writing on newspr an outline of the procedures involved in making a forge poker/rake (see Step 6).

Procedures:

Step 1. (5 minutes)
Distribute Attachment 4-A, "Color/Heat Chart" a Attachment 4-B, "Traditional and Rural Forges" and briefly explain the session objectives and cedures.

Trainer Notes

Explain that the Attachments will be discussed in more detai later in the session.

Step 2. (10 minutes)
Post and briefly define the list of tools and f components that will be used in making a forge poker/rake.

Trainer Notes

* Post the following list on newsprint in two columns as indicated below:

Continued

Trainer Notes

* Appear throughout the session and serve to clarify and explain a procedure, provide information and suggest options.

TRAINING PROGRAM CALENDAR

	DAY 1	DAY 2	DAY 3
A.M.	Session 1: Sharing Perceptions of the Training Program: an Ice-Breaker Session 2: Assessing Group Resources Session 3: Defining Expectations of the Training Program	Session 5: Properties of Metals Session 6: Forging a Blacksmith's Cold Chisel	Session 9: Eye Hook and Link: Technology Transfer Session 10: Forging Rings
P.M.	Session 4: Forge Introduction	Session 7: Forging a Blacksmith's Hot Punch Session 8: Heat Treating	Session 11: Welding Practices: Forge Brazing Session 12: Open Workshop/Mid-Program Review

	DAY 4	DAY 5	DAY 6
A.M.	Session 13: Bellows and Forge Design Session 14: Forging an African Tang-Type Axe	Session 16: Forging a Cross-Peen Hammer	Session 18: Forging Straight Tongs
P.M.	Session 15: Case-Hardened African Field Hoe with Collar	Session 17: Forging Cutting Tools: The Wrapped-Handle Knife	Session 19: Program Evaluation Session 20: Open Workshop/ Clean-up

SHARING PERCEPTIONS OF THE TRAINING PROGRAM: AN ICE BREAKER

Total Time: 1 hour, 15 minutes

Objectives:
* To get to know one another and to encourage communication
* To set the climate for active participation during the training program

Resources: Attachment 1-A, "Coat of Arms"

Materials: Pens or pencils

Trainer Notes

An alternative activity for getting acquainted goes as follows:

* Convene the group in the blacksmith workshop area.
* Ask participants to browse around for a moment and find a tool or object which they would like to make, and which symbolizes something about their
  - personality/character
  - background
  - work
  - aspirations
  - etc.
* The trainer should also choose an appropriate object.
* When everyone has made a selection and has had a few moments to reflect, introduce yourself and explain why you selected your object (using humor to help create a relaxed climate).
* Then, moving around the shop, have the participants introduce themselves and share their reasons for selecting their particular tool.

Procedures: Step 1. (5 minutes)
Distribute copies of Attachment 1-A, "Coat of Arms" and explain the exercise.

Trainer Notes

* Explain that the object of the exercise is to draw a symbolic "coat of arms" which will help us begin to get acquainted or find out something new about each other.
* Explain that the participants will draw a symbol or picture in each of the corresponding spaces on the coat of arms that answers one of a series of questions.

Step 2. (15 minutes)
Referring to the list in the Trainer Notes below, read each question in order, allowing time for people to draw their symbol before moving to the next question.

Trainer Notes

* Suggested questions:
  - How do you feel right now?
  - What were you doing a week ago today?
  - What do you hope to get out of this training?
  - What can you offer this training?
* Draw your own "coat of arms" while the group does theirs.

Step 3. (5 minutes)
After everyone has finished drawing his/her coat of arms, share your coat of arms by explaining the meaning of each of your four drawings.

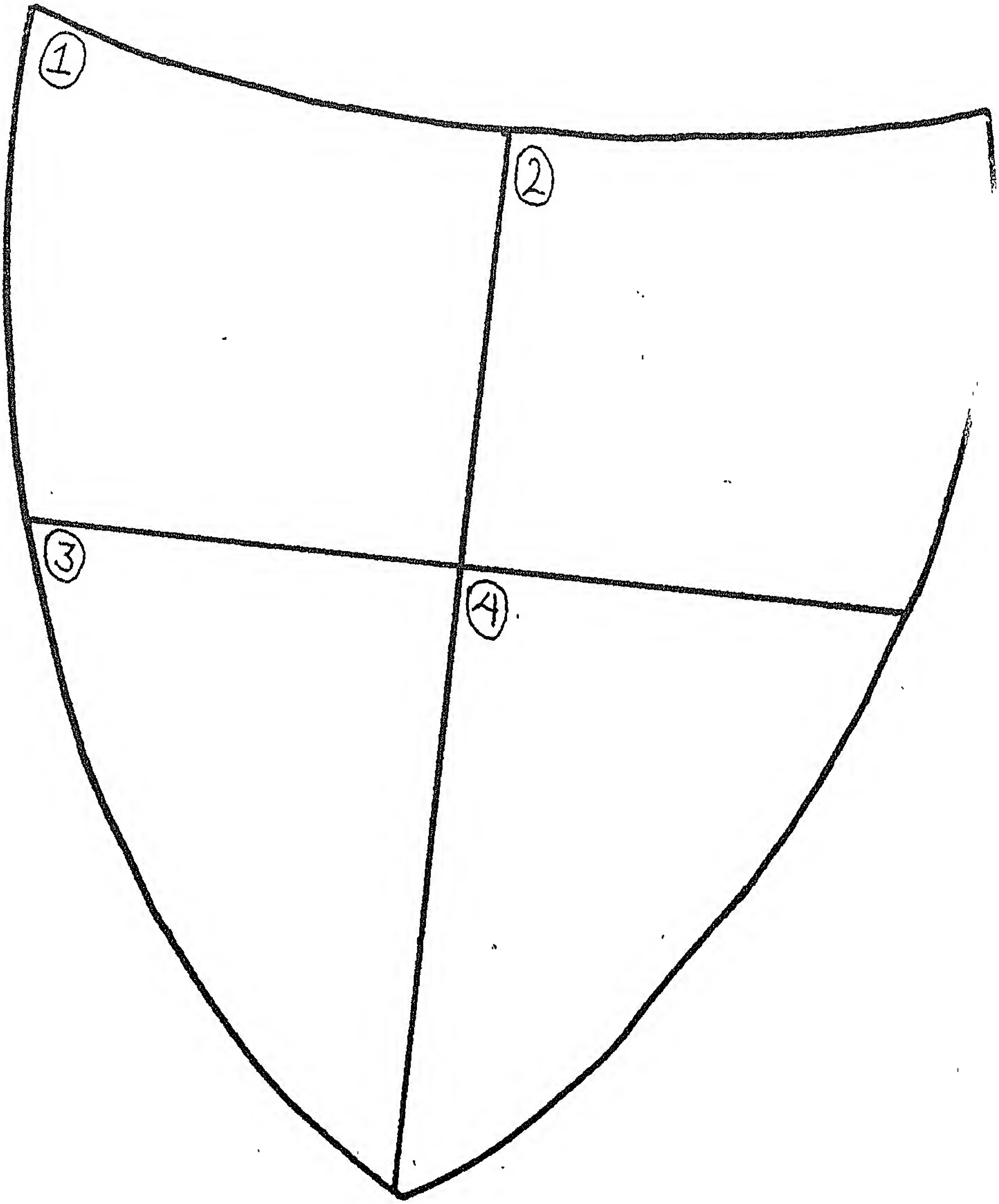
Trainer Notes

Encourage an open climate by explaining your drawings in a relaxed and humorous manner. Also, make your presentation brief to set the pace of the activity.

Step 4. (30-45 minutes)
Have each participant explain the meaning of his/her coat of arms.

Step 5. (5 minutes)
After all of the drawings have been presented, facilitate a brief discussion of some of the similarities and differences which seem to exist in the group.

COAT OF ARMS



ASSESSING GROUP RESOURCES

Total Time: 1 hour, 30 minutes

Objectives:

* To identify the skills, knowledge, and expe of participants and trainers

* To discuss ways in which the group's skill knowledge can be used in this program

Materials: Newsprint and felt-tip pens.

Procedures:

Step 1. (5 minutes)
Review the objectives and procedures for the

Step 2. (5 minutes)
Ask the participants to briefly discuss the v a group resource assessment.

Trainer Notes

Draw on the participants' experiences in working with arti in small-scale development projects.

Step 3 (10 minutes)
Have the group brainstorm a list of interview questions which could help assess the partici skills, knowledge and experience.

Trainer Notes

* To provide focus during the brainstorm, post the key po to be included in the interview: skills, knowledge.

* The resulting questions should be consolidated or pared so that the list does not exceed 4-5 open-ended questio will stimulate conversation.

* In this session, the emphasis is not only on those skil etc. which relate directly to Blacksmithing, but on any resources one might have which would help the group.

Step 4. (5 minutes)
Explain the interview format.

Trainer Notes

The Interview Format

Step 1 (5 minutes)
Find someone in the group whom you don't know well and to a comfortable location.

Continued

Trainer Notes/Continued

Step 2 (30 minutes/15 minutes per person)
Interview one another using the list of questions as guidelines. Jot down brief notes as the conversation proceeds.

Step 3 (10 minutes)
On a clean sheet of paper, write down in legible, paragraph form the information you have gathered from your partner.

Step 4 (5 minutes)
Share the interview sheets with your partner and make any modifications or additions.

Step 5 (10 minutes)
Post the sheets on the wall and walk around the room scanning the other interview reports.

* If the training group is a small one, an option to the written reports would be to have the pairs interview each other, reconvene the groups, and ask each participant to describe his/her partner.

Step 5. (60 minutes)
Have the participants carry out the interview procedure.

Step 6. (5 minutes)
Reconvene the group and facilitate a short discussion of the participants' overall impressions of the resources that exist within the group.

Trainer Notes

During the discussion, point out a number of the identified skills which are particularly useful/necessary in blacksmithing (e.g., carpentry, construction, auto/farm mechanics, welding).

DEFINING EXPECTATIONS OF THE TRAINING PROGRAM

Total Time: 1 hour, 15 minutes

Objectives:

* To review the schedule and content of the program
* To define and clarify expectations that the participants have of the training program
* To compare and contrast individual expectations with those of the program.

Resources:

* Introduction to the Manual, pp. i-ii.
* "Conducting the Training," pp. iv-vi, from the Introduction to the Manual.
* Training Schedule

Materials: Newsprint and felt-tip pens

Procedures:

Step 1. (5 minutes)
Briefly outline the session's objectives and activities.

Step 2. (20 minutes)
Distribute copies of the three resources. Have the participants read them carefully, then ask for questions, clarifications or discussion.

Trainer Notes

Explain that the training philosophy and methodology and the section on conducting the training provide an orientation to the basic program goals and guidelines, while the training schedule presents a day-by-day description of the training.

Step 3. (15 minutes)
Have the participants form small groups and discuss their expectations of the program. Ask each group to list on newsprint and post their three most important expectations.

Trainer Notes

* As they develop their lists, participants should be encouraged to consider their needs and desires, as well as constraints in scheduling and programming.
* If the training group is small, you may wish to remain together and make a master list of participants' expectations.

Step 4. (25 minutes)
Reconvene the large group and review each expectation for clarity, understanding, and feasibility.

Trainer Notes

* Identify which expectations will be met directly, those that will be touched upon, those which could be addressed with some schedule changes, and those, given the practical limitations of the program, which may not be met.

* Wherever possible, point out specific sessions in the Training Schedule which deal directly with the group's expectations.

Step 5. (10 minutes)
Conclude the session by facilitating a discussion centered around the following questions:

* Were any of your expectations changed by this activity?

* Is there anything that you have heard about the training program that has not been discussed?

* Do you think the program will meet your needs?

FORGE INTRODUCTION

Total Time: 4 hours

Objectives:
* To identify and define the basic components of a forge
* To practice using basic blacksmithing tools
* To light, maintain and shut down a forge fire
* To make a forge poker/rake and eye
* To discuss forging practices of local blacksmiths

Resources:
* Attachment 4-A, "Color/Heat Chart"
* Attachment 4-B, "Traditional and Rural Forges"
* Andrews, pages 17-21 and 42-46
* Weygers, pages 20-23 and 94-96

Materials: Approximately 30-36 feet of ½ inch mild steel round bar, newsprint, and felt-tip pens

Trainer Notes

> Preparation for this session will involve writing on newsprint an outline of the procedures involved in making a forge poker/rake (see Step 6).

Procedures:

Step 1. (5 minutes)
Distribute Attachment 4-A, "Color/Heat Chart" and Attachment 4-B, "Traditional and Rural Forges" and briefly explain the session objectives and procedures.

Trainer Notes

> Explain that the Attachments will be discussed in more detail later in the session.

Step 2. (10 minutes)
Post and briefly define the list of tools and forge components that will be used in making a forge poker/rake.

Trainer Notes

> * Post the following list on newsprint in two columns as indicated below:
>
> Continued

Trainer Notes/Continued

Forge Components	Forge Tools
Stand	Anvil and Stand
Hearth	Firetools:
Firebox and Cleanout	Poker/Rake
Blower	Shovel
Chimney and Hood	Sprinkler
Quench Bucket	
Charcoal	

* Stimulate discussion by asking participants to look around the demonstration forge area and point out each of the items listed.

* Ask participants to explain the importance of the positioning of each of the various forge components.

Step 3. (10 minutes)
Ask participants to discuss and define the function of each item on the posted list.

Trainer Notes

* Have participants explain the relationship between each item on the list and the following basic functions:

  - fire maintenance
  - smoke removal
  - clinker removal
  - ash removal
  - positioning of work during heating

Step 4. (10 minutes)
Demonstrate the proper techniques for lighting a forge.

Trainer Notes

* During the demonstration, it is important to explain the following:

  - essential safety precautions
  - type of fuel used
  - alternative fuels (i.e., coal or propane)
  - proper use of bellows or blower
  - proper building and banking of fire
  - allowing forge bowl to heat

Step 5. (15 minutes)
Have the participants form work teams of two and light the forges at each of their work stations.

Trainer Notes

Circulate among the stations and provide assistance whenever necessary.

Step 6. (10 minutes)
Reconvene the group and briefly outline the procedures involved in making a forge poker/rake.

Trainer Notes

* Post on newsprint the following outline:

- position cutting plate on anvil
- cold cut 3' length of ½" round bar
- place material in fire
- bring material to proper heat for mild steel
- hammer
- bend an eye
- flatten end

Step 7. (25 minutes)
Demonstrate the procedures and techniques involved in making a forge poker/rake.

Trainer Notes

* Remind participants of the importance of carefully observing each step in the process and taking note of any procedures which may appear confusing or too fast.

* To the extent possible, as the work progresses, provide brief explanations of each essential technique and point out transitions from one step to the next by referring participants to the posted outline.

Step 8. (20 minutes)
Using the posted outline as a guide, ask participants to review and explain the techniques which they observed.

Trainer Notes

* Remind participants of the demonstration format discussed earlier in the day (see Session 3, "Defining Expectations: An Introduction to Training") and stress that it is important to begin to sharpen their observation skills.

Continued

Trainer Notes/Continued

* In reviewing the heating of mild steel to the proper temperature, refer participants to Attachment 4-A. "Color/Heat Chart" and explain that this chart will be used later as a guide in hardening steel.

* Before proceeding to the next step, it is important to be certain that all the participants understand each of the techniques demonstrated as well as the necessary safety precautions involved in handling the hot metal.

* Encourage participants to ask questions and seek clarifications.

* If necessary, repeat some or all of the techniques until participants are satisfied that they are ready to begin work at their stations.

Step 9. (65 minutes)
Have participants return to their work stations and make a forge poker/rake.

Trainer Notes

* Circulate among the stations and provide assistance whenever necessary.

* If there are any members of the group that have had experience with forging and hammering, ask that they help others who may be experiencing difficulty.

* During this first forge activity, it is essential to carefully monitor each of the work teams and stress the importance of a strict adherence to safety procedures involved in handling hot steel.

* It can be expected that a few of the work teams will finish their pokers in 15-20 minutes. If this occurs, encourage teams to make another poker/rake such that each participant has the opportunity to practice and become comfortable with the techniques involved.

Step 10. (15 minutes)
As each team finishes their poker/rake, have them shut down their fires.

Trainer Notes

* Each team will be completing their work at slightly different times. Briefly explain and demonstrate the proper procedures for shutting down a fire to the first team that finishes.

Continued

Trainer Notes/Continued

Ask that they provide assistance to the next team that finishes. Continue in this manner such that each team has the opportunity to help another shut down a fire.

Step 11. (20 minutes)
Reconvene the group and ask participants to identify and discuss any difficulties which they experienced during the forging activity.

Trainer Notes

* Stimulate discussion by asking how each difficulty was resolved.

* Explain that the basic techniques used in bending and forming the eye of the poker/rake will be used in Session 9 on Day 3 to make eye hooks and links and ask participants to identify examples of potential uses for eye hooks and links.

Step 12. (15 minutes)
Ask participants to discuss how the techniques used in this activity compare with techniques that they have seen used by local blacksmiths in their work sites.

Trainer Notes

* Refer participants to Attachment 4-B, "Traditional and Rural Forges" and stimulate discussion by asking:

  - How are the tools and forges used by local blacksmiths different from those used here in the training? Why?

  - Are the techniques used by local blacksmiths more efficient? Less efficient? How?

  - What are some cultural and economic factors which determine the techniques used by local blacksmiths?

Step 13. (20 minutes)
Conclude by asking participants to summarize the basic blacksmithing techniques used during the session.

Trainer Notes

* Some important points to include in the summary are:

  - fire building
  - fire maintenance
  - air flow control
  - safety precautions
  - heating steel
  - color/temperature ratio

Continued

Trainer Notes/Continued

- drawing out
- spreading/peening
- bending metal
- making eyes/links
- proper use of tools
- local blacksmithing techniques
- fire shut-down
- uses of eyes and links

* Explain that the basic techniques and tools introduced during this session will provide a framework upon which to build throughout the training program.

COLOR/HEAT CHART

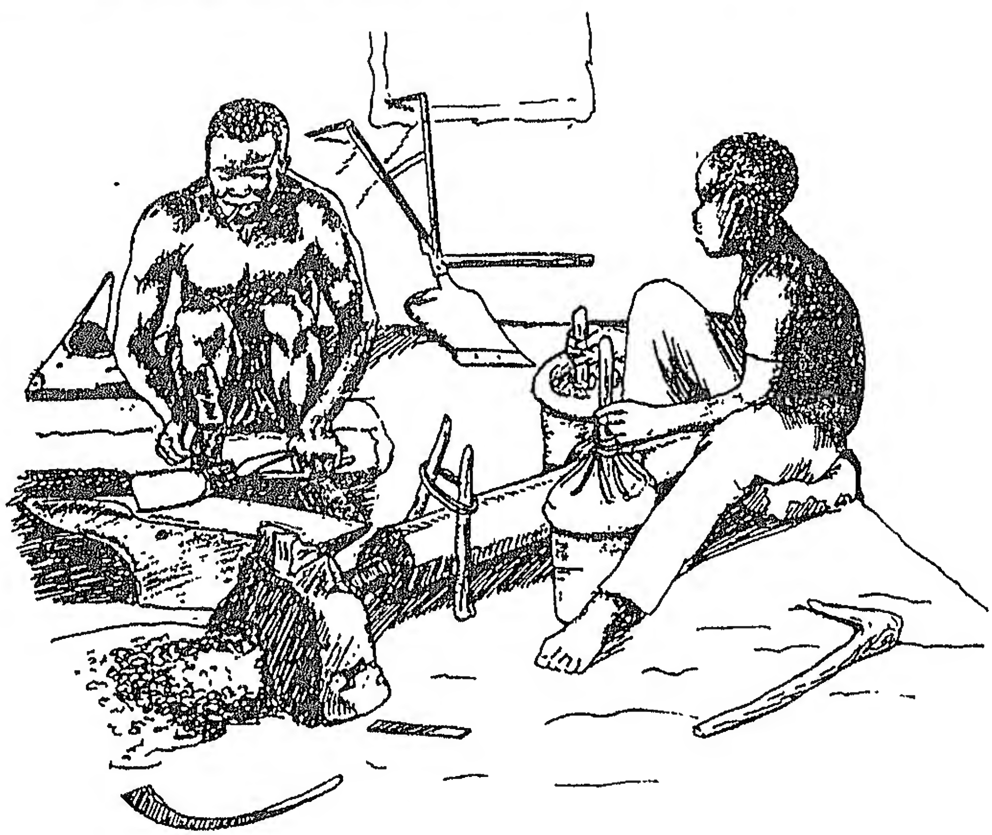
Heat Colors

F°		C°
2500	white	1371
2400	light yellow	1316
2300		1260
2200	yellow	1204
2100		1149
2000	yellow orange	1093
1900		1038
1800	light orange	982
1700		927
1600	medium orange	871
1500		816
1400	medium cherry	760
1300		704
1200	dark cherry	649
1100		593
1000	black heat	538

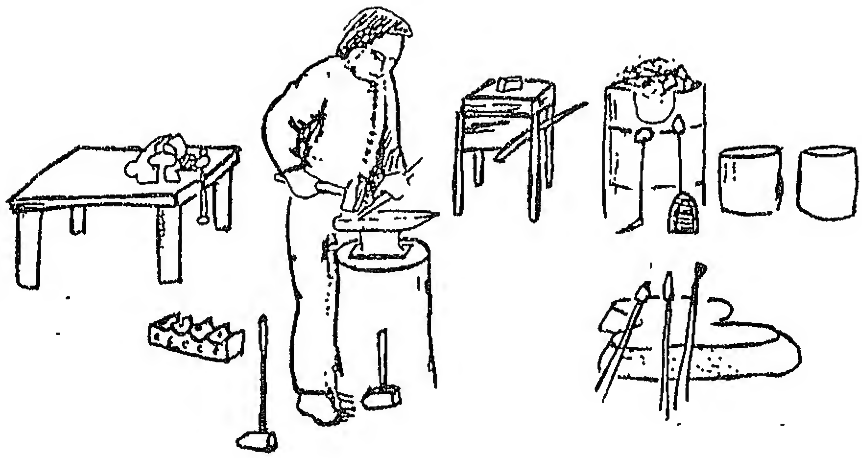
Color Patina

F°	
610	light blue
590	dark blue
570	blue
550	dark purple
540	purple
520	brownish purple (peacock)
510	dark brown
500	bronze
490	dark straw
470	light straw
450	yellow
440	light yellow

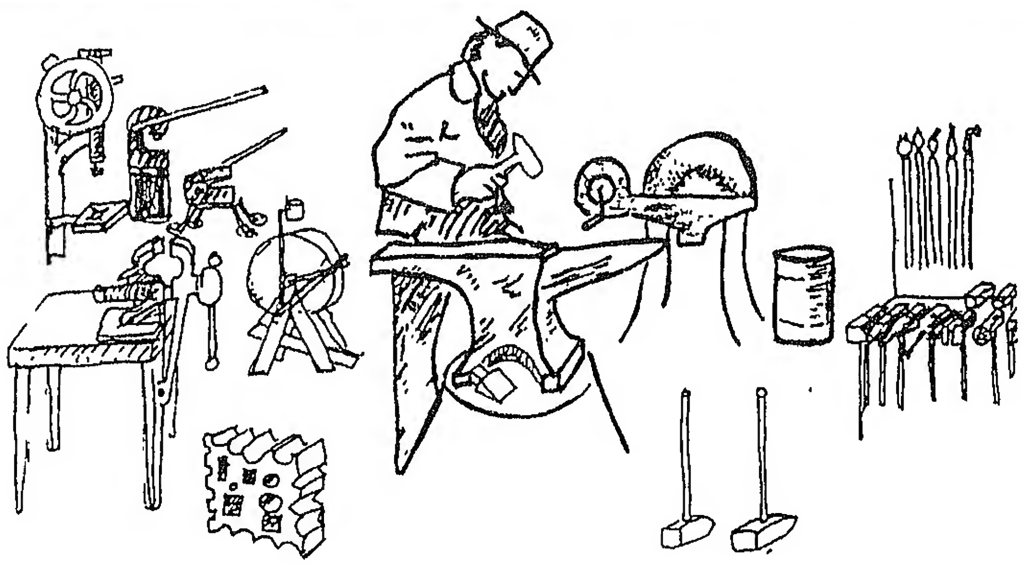
TRADITIONAL AND RURAL FORGES



TRADITIONAL SHOP



RURAL SHOP



HAND-POWERED PRODUCTION SHOP

PROPERTIES OF METALS

Total Time: 1 hour

Objectives:
* To determine the type/grade of available junk steel
* To discuss the properties and characteristics of various grades of steel
* To identify potential uses of available steel

Resources:
* Attachment 5-A, "Identifying and Testing Scrap Meta
* Andrews, "Carbon Content of Steel for Different Uses," page 127
* Weygers, "Steel for Blacksmith," page 15

Materials: A variety of junk steel salvaged from wrecked autos and rail cars; e.g., leaf springs, coil springs, axles, torsion bars, linkage rods, push rods, valves, rail tie, plate, rail spikes, rail section, side or bed plate from rail car, sill from rail car, etc.

Procedures:

Step 1. (10 minutes)
Explain the objectives and distribute Attachment 5-A, "Identifying and Testing Scrap Metal." Ask the group to read it.

Step 2. (15 minutes)
Select a piece of junk steel and demonstrate how to identify its type and properties.

Trainer Notes

* Note and discuss the significance of color, weight, surface finish, sound when dropped, and flexibility.
* Have the participants discuss the junk items' previous use and postulate the type of steel of which it is made.
* Describe and perform the spark and quench tests to further verify the type of steel.
* Based on the reading, the tests, and the previous use of the item, ask the group to discuss its composition (% of carbon) and qualities (hardness and elasticity).
* Explain how heating, forging, and heat treating affect the characteristics of different steels.
* Discuss the advantages and disadvantages of the three types of steel.

Step 3. (15 minutes)
Have participants divide into four groups and select, identify, and describe the properties of an item of junk steel.

Trainer Notes

* Explain that the groups should follow the same identification procedure as done by the trainer until they are fairly certain of the type of steel.

* Stress that not all of the testing methods necessarily have to be used.

* Assist groups who may be having difficulty.

Step 4. (10 minutes)
Reconvene the groups and have them report on their junk item.

Trainer Notes

If a group's conclusion is inaccurate, discuss their identification process in order to pinpoint where they went wrong.

Step 5. (10 minutes)
Have participants examine the chart on Page 4 of the Attachment and identify potential uses of the scrap items listed.

Trainer Notes

* Ask the group to focus on those items most available in their areas.

* Explain that the chart can serve as a resource in the future for identifying possible sources of material.

IDENTIFYING AND TESTING SCRAP METAL

Identification

A variety of unknown types of steel are encountered when working with scrap metal. Several simple tests exist which the blacksmith may use to identify these unknowns. Because of logistics, it may not be possible to perform all of the tests, but with one or two of these tests and some epxerience, one can learn to recognize useful metal at a glance.

There are several types of "steel" that (for the most part) we will not be dealing with in the context of these classes. They are: cast steel, cast iron, high alloy steels, and stainless steel.

The other common metals found in scrap that we will not deal with are copper and aluminum; we will use brass for brazing.

The types of steel that we are looking for may be divided, for the sake of simplicity, into three categories: low carbon, medium carbon, and high carbon steel. The percentage of carbon present determines the major properties (i.e., hardness, fusibility, toughness). Only the medium and high carbon steels are temperable.

Low Carbon: contains about .05-.30% carbon and of the three, because of the relative low cost of production, it is used extensively. Some sources of low carbon scrap are car bodies, some types of rebar, old nails, bolts, panels on railroad cars, railroad spikes, some types of angle iron, rolled pipe, some types of wire, nails, straps, hinges, tanks, drums, etc. It is manufactured in rolled bars, and the most common ones are round, flat or square bars of ¼ - 1". It is NOT temperable but may be forge welded.

Medium Carbon: contains roughly .30-.60% carbon. It is a harder material (harder to work and harder to find), and may be tempered. It is the most available temperable scrap metal. Some sources are springs, axles, torsion bars, gearshift bars, shock absorber bars, and, in general, anything that must stand up to a higher degree of stress and strain. It will not bend easily like mild steel. It is also used where tempering is required (e.g., auto/truck axles, auto/rail car springs, leaf springs, steering columns).

High Carbon: contains roughly .60-1.5% carbon, and usually has an alloy present. It is much harder than medium carbon, but is available in scrap sometimes as old pneumatic drill bits, old bulldozer blades, milling cutters, metal saws, cutting dies, threading dies, and files.

Testing

Spark Test: Hold a piece of the material in question against a high-speed grinder and closely observe the sparks given off. Generally, the brighter and more explosive the spark, the greater the carbon content of the steel in question. Try known pieces and study their relationships.

Sound Test: If the piece is small enough, lightly toss it onto a concrete floor or stone. Listen for the sound, and compare the sound to known pieces.

Cold Chisel Test: Using a sharp cold chisel and light blows, attempt to cut the beginning of a curl from the material in question, noticing the following points:

- Does the material cut easily or does it resist?

- If it resists, does it nick the chisel blade?

Again, compare a known material with the piece in question.

File Test: This test is fairly self-explanatory. Using a file, test the surface for hardness. This also reveals the color of unoxidized metal.

Hardening Test: Take the piece in question and heat its tip to light cherry or dark orange and quench it in water. Test it with a file, and note:

- Does the file slide over it like glass?

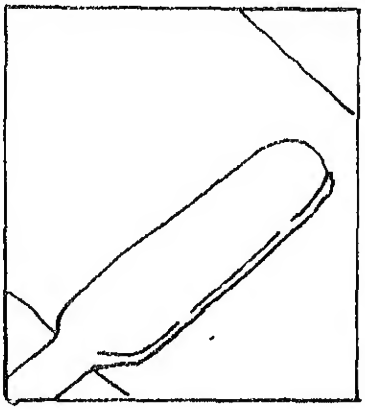
- Do the teeth bite slightly, or is there no difference between the hardened part and the rest of the piece?

Again, if in question, test against a known piece.

Previous Use: One of the most important clues in determining the type of steel in question (whether tempered or not) is to be found in its previous use. If a piece of steel would have needed to be exceptionally tough, tempered, and/or abrasive-resistant to perform its function (e.g., torsion bar, spring, pneumatic bit), then we can assume with greater certainty that it is some type of medium to high carbon steel.

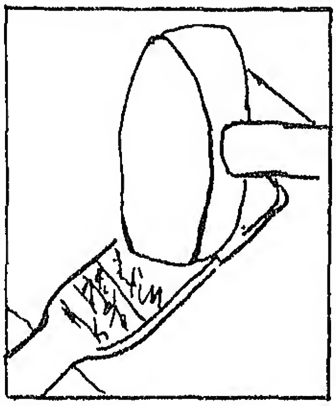
TEMPER TEST

If an untested spring is to be used for tool making, it is advisable and practical to perform the temper test.

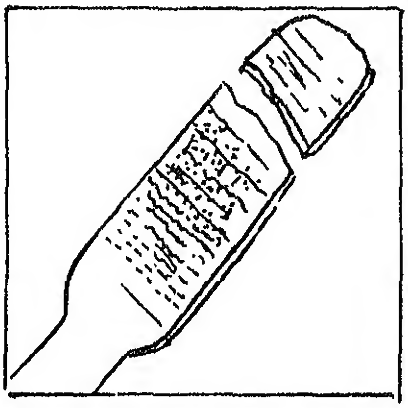


Flatten evenly a 4" section.

Perform the water quench (heat reserve method) on the end, quenching before the colors run the entire length of the piece.



Strike with hammer.



Critical color is determined by where the break occurs in relation to the patina. Tools from this spring should then be tempered at the color/temperature prior to the critical color.

METAL \ TEST	COLOR	SOUND	BENDING	MAGNETISM	SPARK	FILE	COLD CHISEL	PREVIOUS USE (EXAMPLES)
ALUMINUM	silver, oxidizes white	high-pitched ringing	varies	non-magnetic	none	easily & clogs teeth	easily	non-ferrous (cans, roofing)
STAINLESS STEEL	silver, does not oxidize		tough	both magnetic & non-mag. types		smoothly		
COPPER	soft reddish-orange		bends easily					
CAST IRON		no ring; thin pieces break when dropped	brittle, will not bend	magnetic	dull red lines	easily	chips	evidence of mold
CAST STEEL						files, but is tougher than cast iron		evidence of mold
LOW CARBON STEEL			easily		bright reddish, non-explosive	files		
MED. CARBON STEEL			very difficult to impossible		bright, semi-explosive	files		
HIGH CARBON STEEL			does not bend		very bright, explosive	difficult		
BRASS								

FORGING A BLACKSMITH'S COLD CHISEL

Total Time: 3 hours

Objectives:

* To identify and discuss different types of chisels and steels suitable for making chisels
* To practice uncoiling an automobile spring
* To hot-cut steel
* To make a cold chisel blank
* To use a grinding wheel and practice grinding techniques

Resources: MacPherson, "The Cold Chisel"
Weygers, pages 45 and 59

Materials: Automobile coil spring, 1/2" to 5/8" diameter (1¼ cm) (each team should have one coil spring available at their station), several types of chisels, woodworking metalworking, stoneworking, etc.

Trainer Notes

* The chisels distributed in Step 2 should be assembled in advance.
* The procedure for making the cold chisel should be prepared on newsprint and ready to post in Step 9.

Procedures:

Step 1. (5 minutes)
Explain the objectives and outline the procedures.

Step 2. (10 minutes)
Identify and pass out several different types of chisels. Ask participants to try to determine the uses, properties, and forging methods of each one.

Trainer Notes

* Have the group compare the shape and design of the chisels.
* If possible, invite the group to experiment cutting with the chisels.
* Discuss the significance of the angle of bevel in cutting edges.
* Ask participants to speculate on the type of steel and temper of the various chisels.

Continued

Trainer Notes/Continued

* Also ask participants to give examples of how they have used one or more of the chisels in their work.

* Describe some potential dangers in chisel use, e.g., chipping the blade, striking hand with hammer.

Step 3. (5 minutes)
Ask the group to refer to the list of scrap metals from the last session and identify which ones would be most suitable for chisel-making.

Step 4. (5 minutes)
Display a cold chisel and ask the participants to explain its properties and uses.

Trainer Notes

* Refer the group to Session 4 when they used a cold chisel to cut round bar.

* Have them discuss other potential uses.

* Based on the chisel's function, ask the group to determine its carbon content and temper.

Step 5. (5 minutes)
Light your forge.

Trainer Notes

* If coal is used as a fuel, demonstrate how to build a fire using coke remaining from the first fire.

* If possible, ask one member of the group to review the steps involved in lighting the forge and have another assist you.

Step 6. (10 minutes)
Heat and uncoil two linear feet of bar from an automobile spring.

Trainer Notes

Emphasize to the group:

* the correct positioning of the coil spring in the fire

* the periodic turning of the spring to prevent burning

* the banking of the fire around the spring

Continued

Trainer Notes/Continued

* the importance of even heating

* the proper use and type of tongs for holding the spring

Step 7. (5 minutes)
Explain to participants how to determine the length of bar necessary to forge a chisel, to determine the point, and to hot-cut the bar accordingly.

Trainer Notes

Be sure to point out:

* that the spring should be cut most of the way through, then broken, to avoid damaging the hammer on the hardy

* that the hardy should be removed from the anvil when finished

* safety hazards involved in the process (i.e., hot foot)

Step 8. (25 minutes)
Have participants go to their assigned stations and ask each team to light the forge, heat and uncoil the available spring, and hot-cut the straightened bar to be used for the chisel.

Trainer Notes

* To make sure all participants understand the task, ask for a volunteer to repeat the steps. Also, ask if there are any questions before beginning.

* During the work, circulate among the stations providing input when necessary and encouraging appropriate hammering and accurate blows.

* Be sure to point out any hazardous practices.

Step 9. (5 minutes)
Reassemble the participants around your station, and explain the steps involved in making a chisel.

Trainer Notes

* Point out what you expect to accomplish during each heat and mention that they can expect to accomplish less for each heat.

* Have the steps outlined and posted on newsprint.

Continued

Trainer Notes/Continued

* The following steps may be included on the list:
  - forge stock into eight-sided octagonal bar
  - forge main bevel
  - grind cutting edge
  - chamfer striking end

Step 10. (10 minutes)
Demonstrate the forging of the cold chisel.

Trainer Notes

* Refer to each step as you work.
* Before you grind the demonstration chisel, point out injuries which can occur from improper grinding practices (i.e., the importance of wearing safety glasses).

Step 11. (5 minutes)
After the demonstration, review the steps with the group.

Trainer Notes

* Ask if there are any more questions before the group makes their chisels.

Step 12. (1 hour, 15 minutes)
Have participants return to their stations and forge, grind and chamfer the cold chisels.

Trainer Notes

* Again, circulate among the stations, giving input regarding hammering techniques, safety, etc.
* Have teams who finish early assist others in the final steps of grinding and chamfering.

Step 13. (10 minutes)
Reconvene the large group and ask the participants to identify and discuss problems encountered while making their chisels.

Step 14. (5 minutes)
Conclude the session by explaining to the group that they will temper their chisels during Session 8, "Heat Treating."

Trainer Notes

Briefly mention that the chisels are incomplete until annealed and tempered; two processes which will be discussed in depth during Session 8.

FORGING: A BLACKSMITH'S HOT PUNCH

Total Time: 2 hours

Objectives:
* To identify and discuss different types of punches and their functions
* To make a blacksmith's hot punch

Resources:
* Andrews, page 52.

Materials: 10 - 15 automobile coil springs (6" length and 3/4" to 5/8" in diameter), and a variety of punching tools

Trainer Notes

> The punching tools distributed in Step 2 should be assembled in advance. They should include at least two types of hand-held blacksmith's hot punch, several cold punches, drifts, mandrels, an awl, nail sets, and center punches.

Procedures:

Step 1. (5 minutes)
Explain the session objectives and briefly outline the procedures.

Step 2. (10 minutes)
Distribute among the participants a variety of punching tools used by crafts people and discuss thei[r] uses and properties.

Trainer Notes

> * Stimulate a discussion of each tool by asking:
>
>   - What are some potential uses for this punch?
>   - What can be determined regarding the qualities of the steel from which this tool is made?
>   - What are some scrap steels from which this tool could be made?
>   - Which of these punches are used by local crafts people at your work sites?

Step 3. (10 minutes)
Focus the discussion on the hand-held blacksmith's hot punch and ask participants to identify how it is used.

Trainer Notes

Some important uses of the punches which should be mentioned include:

* piercing sheet metal (cold)
* center punching to mark stock
* driving out old rivets, shafts, etc.
* hot punching
* drifting (enlarging) holes

Step 4. (10 minutes)
Briefly explain the procedures involved in making a blacksmith's hot punch.

Trainer Notes

* Be brief in your explanation and be sure to mention the importance of making the hot punch long enough to allow holding it while maintaining a safe distance from the heat of the piece being punched.

* Point out and explain the parallels which exist between the procedures for making a hot punch and those involved in making a cold chisel.

* Explain that the punch blanks will be annealed and tempered in the next session, along with their cold chisels.

Step 5. (15 minutes)
Demonstrate the techniques involved in making a hot punch.

Trainer Notes

* Before beginning the demonstration, remind participants that they should observe carefully and note any procedures which appear confusing and may need to be clarified later.

* During the demonstration, focus your explanation on identifying transitions from one major step to the next.

Step 6. (10 minutes)
Have the participants review and explain the procedures and techniques which they observed.

Trainer Notes

* Before proceeding to the next step in this session, be certain that all the participants have had the opportunity to clarify the procedures such that they are ready to begin working at their stations.

Step 7. (50 minutes)
Have participants form their work teams and practice making a hot punch.

Trainer Notes

* Circulate among the groups making suggestions, providing assistance, and pointing out safety precautions and examples of good hammering posture.

Step 8. (10 minutes)
Reconvene the group and ask participants to discuss and share among themselves any technical difficulties which they encountered and what they did to overcome them.

HEAT TREATING

Total Time: 2 hours

Objectives:
* To define and discuss the terms hardening, annealing, and tempering.
* To anneal steel.
* To temper steel.
* To evaluate the problem-solving techniques used by the work teams.

Resources:
* Attachment 8-A, "Water and Oil Quenching"
* Andrews, pages 49-53
* Weyger, pages 36-37
* Weyger, back cover

Materials: Chisels and punches made during Sessions 6 and 7; a piece of coil spring for demonstration of tempering.

Procedures:

Step 1. (5 minutes)
Explain the session objectives and briefly outline the procedures.

Step 2. (15 minutes)
Distribute Attachment 8-A, "Water and Oil Quenching" and ask participants to define and discuss the terms annealing, hardening and tempering.

Trainer Notes

* Stimulate discussion by having participants describe common techniques used by local blacksmiths to harden steel.
* In defining the terms be certain that the following key points are discussed:
  - the method of water-quenching in hardening and tempering
  - the method of oil-quenching in hardening and tempering
  - the concept of correct hardening temperature
  - degrees of hardness
  - the importance of annealing before hardening to relieve built-up stresses
* If available, distribute among the participants examples of tools which have been tempered and annealed and have them explain why it is important to harden certain tools.

Step 3. (20 minutes)
Using a punch and chisel blanks made during the previous sessions, demonstrate the proper techniques involved in annealing and tempering.

Trainer Notes

* Before beginning the demonstration, briefly describe the procedures to be followed and remind participants to observe carefully. During the demonstration, mention and point out the following:

  - that annealing is a slow process which can take 20-30 minutes in some cases
  - that the tempering area should not be windy since this causes scaling
  - that the fire should be clean and free of clinkers and other debris
  - that oxidation can be minimized by maintaining a low, steady air blast
  - that care must be taken not to burn cutting edges while heating the stock
  - signs and causes of steel stress and over-heating

* Following the demonstration, take a few minutes to ask participants to review and clarify the important techniques which they observed.

Step 4. (45 minutes)
Have the participants go to their work stations and anneal and temper the punches and chisels which they made in Sessions 6 and 7.

Trainer Notes

Circulate among the teams and provide assistance and guidance whenever necessary. However, it can be assumed that, at this point, the participants have become more comfortable with the forge environment. It is important to begin to limit interventions by the trainer to situations involving potential safety hazards and/or situations in which participants are involved in fruitless pursuits which will prevent successful completion of the task. In this manner, by encouraging as much independent experimentation as possible, the participants are given the opportunity to creatively solve their own problems.

Step 5. (15 minutes)
Reconvene the group and ask participants to discuss and share among themselves any difficulties which they encountered and what they did to overcome them.

Trainer Notes

Explain that they will be annealing and tempering other tools during the week to strengthen their skills.

Step 6. (20 minutes)
Have the participants discuss the problem-solving techniques used in their work teams up to this point.

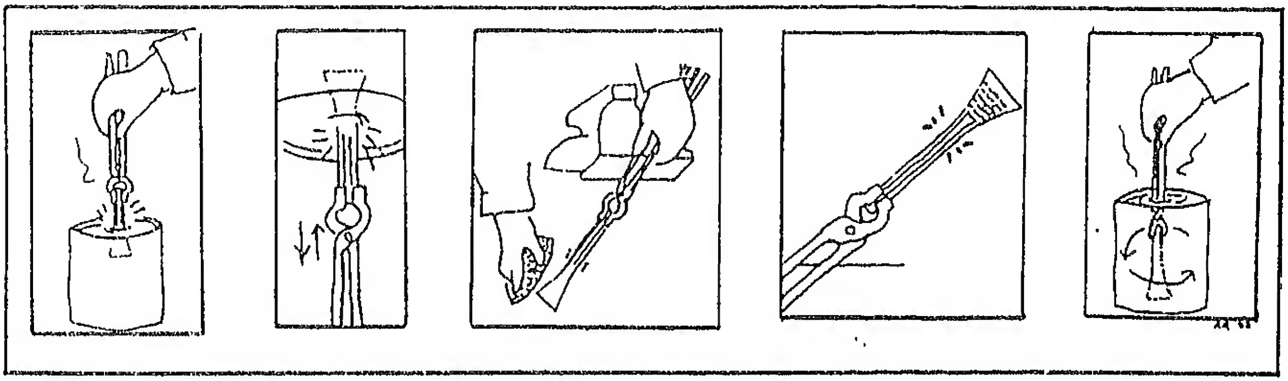
Trainer Notes

* Briefly explain that in order to transfer ths skills which they acquire during this training, participants will, most likely, be communicating and working cooperatively with a local blacksmith.

* Stimulate discussion and dialogue among the participants by asking the following questions:

  - What are some examples of situations in which it was difficult for your team to work effectively?
  - What was done to help solve these problems and move on?
  - What factors served to inhibit effective problem-solving?
  - What can be done in the future to improve your team's ability to work more effectively and cooperatively?
  - To what extent does the work team design of this training reflect the situation of working with a local blacksmith at your sites?

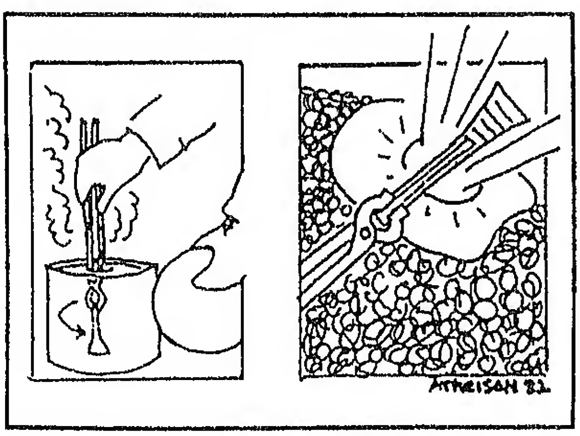
WATER AND OIL QUENCHING



WATER QUENCHING (Heat Reserve Method) - After bringing 3" of the blade end of the piece up to heat:

- quench only the tip (1½") leaving the next 2" or so unquenched.
- move the piece up and down ½" in water rapidly to prevent forming a fracture zone where heat contacts water. Maintain this until the heat glow has diminished to a dull cherry.
- Remove the piece from quench and briskly polish the blade surface with an abrasive. Hold the piece with blade upward and observe the color patina as the heat from reserve moves toward the edge. When the desired color reaches the edge, then quench quickly with a swirling motion.

OIL QUENCHING - After bringing 2" of the blade end up to heat:



- with a swirling motion, plunge completely in oil quench bucket, holding the lid nearby in case of an oil flash. If the oil flashes, pull tongs out of the way and snuff fire with tight-fitting l
- After the piece has been quenched in oil and is cool to the touch, polish and draw color patina over a propane flame or in a forge, using a metal plate with a hole cut in it (or fire bricks) to direct heat to the piece.

TABLE OF CONTENTS

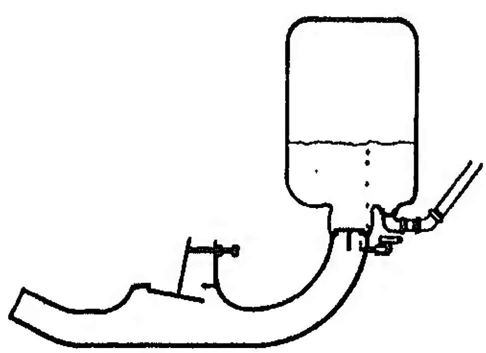
FOREWORD

In 1772, John Whitehurst developed the first known machine to utilize the water hammer effect to pump water. Whitehurst's device included a water supply tank, a 1½ inch, 600 foot long drive pipe, a check valve, an accumulator and a delivery pipe. He used a hand-operated impulse valve, employing child labor to open and close the valve in continuous cycles.

In 1776, Joseph Michael de Montgolfier invented a similar machine but replaced the hand operated valve with an automatic impulse valve which was opened and closed by the rebound wave inside the hydram itself. Montgolfier's machine was called "le belier hydraulique," from which the term "hydraulic ram" was derived. (Because "hydraulic ram" can have more than one meaning, however, we prefer the British term "hydram" to describe these water pumping devices, and will use this term throughout this manual.) The invention was so simple and reliable, it has survived over 200 years with very little change.

The technical information contained in this manual has been developed through experiments and experience. We have tried to present the fruits of our experience in such a manner as to be easily transferred to other situations and applications. The transfer cannot always be complete, however, and situations cannot always be predicted. The performance of a hydram is dependent on many variables. The information contained in this manual should therefore be regarded as guidelines based on past experience, rather than absolute rules.

David Jessee
Perennial Energy, Inc.



INTRODUCTION

Introduction

This training manual presents a comprehensive training design, suggested procedures, and materials for conducting a workshop in the design, construction, operation, maintenance and repair of hydrams, and planning and implementing hydram projects. It includes sessions for the design and construction of modified and fabricated pipefitting rams and cement rams, and complete instructions for a clear PVC demonstration ram. The training design incorporates a variety of active learning techniques and can be modified to fit the skills and needs of the participants. The workshop requires ten, eight hour working days. The activities have been designed for 15-20 participants with two trainers.

The training design is only as effective as the trainers who are using it. Trainers must have skills and experience with hydrams as well as training. They may find it necessary to modify the design to accommodate participants'skills and needs, the amount of time available for training, actual conditions at the training site, the number of participants and their training style. The success of the design, however, depends on the amount of practice and application participants experience.

This manual was produced under a Participating Agency Service Agreement between Peace Corps and the U.S. Agency for International Development. The initial work, including the technical content and material was prepared by Perennial Energy, Inc., which has conducted pre-service training for Peace Corps Volunteers. David Jessee, Ted Landers, Jay Dick, Brad Jacobs and Pat Wiersma were Perennial's significant contributors.

Trainers who participated in a selection and orientation workshop offered insights for revisions. That group included: Jim Bell, Paul Jankura, Steve Joyce, Dale Krenek, John Leo, Jack McCarthy, Judith Oki, Christopher Szecsey, Chris Walters, Maurice Wells and Terry Whitington.

The design was piloted in Costa Rica, by Dale Krenek, in Lesotho by Dale Krenek, Judith Oki and Terry Whitington; and in Fiji by David Jessee, Dale Krenek and Judith Oki. Those experiences completed the design revisions incorporated here.

Ongoing design, editing and production has been the task of the entire Peace Corps Energy Sector: Paul Jankura, Ada Jo Mann, Prudence Merton, and Pat Riley.

Judith Oki
Energy Training Specialist
Office of Programming and
Training Coordination,

October, 1981

GUIDELINES FOR USERS

A. Training Objectives: By the end of the workshop, participants will be able to:

- survey and evaluate sites for potential hydram projects;
- articulate and apply hydram theory;
- use correctly basic water and distance measurement techniques and formulas for proper sizing of hydrams;
- select proper ram design and size;
- list tasks and resources necessary to develop a water source site for hydram operations, and
- design water distribution system including storage tank, stand pipe, supply lines, etc.;
- construct a pipefitting and/or concrete hydram;
- operate, maintain, troubleshoot and repair hydrams;
- identify issues in training local community members in the installation, operation and maintenance of hydrams;
- identify physical, social and institutional requirements for the successful application of this technology; and
- describe an action plan for using this technology in their real life situation.

B. Training Activities: The workshop design requires the involvement of each participant, individually, in small groups, and the large group. The activities are designed to provide maximum opportunities for participants to practice the skills they're acquiring and consider issues specific to their sites.

Activities include:

- demonstrations
- problem-solving (individually, small group, large group)
- skill practice, guided construction (small group)
- group discussion (small and large group)

As the workshop evolves, participants are required to solve increasingly complex problems on paper and in skill practice. Throughout the workshop, participants are asked to identify key issues in hydram application and project development.

Manual Organization

The training sessions each include learning objectives, recommended time, suggested procedures, and the specific tools, materials and resources required. Notes to the trainer are in the right hand "margin" and space is provided there for additional notes.

All handouts appear twice in this manual. Once at the end of the session in which they are used and collectively as an appendix for easy duplication.

Preparation for Training

The following is a list of logistics and tasks that need to be completed during the planning process. Specific tasks that need to be completed before each session are listed within the session.

1. Become familiar with the training design, sessions and materials in the manual.

2. Gather information about the availability of skills, equipment and materials at or near the training location. The practical nature of this workshop requires the availability of basic carpentry, plumbing, and some metalworking tools, as well as parts and materials for the different ram constructions. A checklist is provided.

3. Based on the information gathered, and proposed applications, select the constructions that will be covered in depth.

   Note: The concrete construction is easier to understand after participants have acually constructed a simple ram, i.e., pipefitting or clear PVC. The concrete construction must take place over at least 6 days in order to cure enough to operate.

4. Identify the training site. The ideal training site provides space for the full range of training activities within easy walking distance from each other:

   - classroom space for small and large group work; chalkboard, newsprint, slide projector, table space;

   - enough workshop space to accomodate all participants in construction activities; workbenches, tool storage, first aid station;

- field activities:

    1) a stream/springs nearby where participants can practice measuring water flow, distance, head;

    2) an area where participants can take a number of measurements to determine an ideal location for a hydram. The site must offer a range of choices;

    3) space where a demonstration ram can be installed easily, or proximity to an actual installation;

    4) experimentation: space must be available for participants to operate and troubleshoot hydrams. These activities represent 2-3 days of the workshop. The space must provide sufficient stations for constructed rams - 1 station per 3-4 participants is recommended. The water source must supply a constant Q and variable H. An example experimental station is provided at the end of this section.

    If these facilities are not near each other, then travel time must be included in the schedule and transportation arranged.

5. Determine number of trainers required. 1 trainer: 7 participants is an ideal ratio, but with a strong technical assistant trainer, a 1:10 ratio is manageable. The important thing is participant access to skilled resources during their practical work.

6. Announce the workshop and identify participants. Send each participant information on dates, logistics, a set of workshop objectives and the site information worksheet, included here in appendix of handouts. (1B, 2E)

7. With other trainers, develop norms for the training team, clarify roles and expectations, review status of steps 1-6 to date, develop a final schedule, make training and preparation assignments; decide when to do review exercises, and mid-point and final workshop evaluations.

8. Duplicate handouts.

9. Finalize materials list, based on number of participants and decision on types of construction. Order materials, and arrange for transport to training site.

10. Assemble handouts (pre-punch for ring binders if possible), chalkboard, chalk, newsprint, markers, tape, notebooks, ring binders, schedule.

11. Construct clear PVC ram if necessary for demonstration. The instructions are included here. Session 2 is readily understood with the assistance of this visual aid. If you determine that each participant should construct one, then schedule that early on in the workshop.

12. Certificates of completion add a nice touch, and should be designed and printed.

WORKSHOP: TOOLS, EQUIPMENT, MATERIALS

Quantities vary according to training group size.
Approximately 1 complete set per 4 trainees.

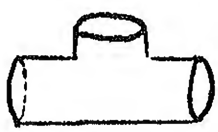
	On hand at training site	Can be borrowed from:	Can be purchased from:	Approx Cost:
Standard size buckets, e.g., 20 liter, 5 gal				
2-3 55 gal drums				
3-6 21" pipes 3/4" Diam diameter				
Lumber for molds, weirs, braces				
Sight levels				
Carpenters levels				
Measuring tapes				
Pliers				
Pipe Wrenches				
Hacksaw				
Hammers				
Shovels				

	On hand at training site	Can be borrowed from:	Can be purchased from:	Approx Cost:
Picks				
Saws				
Various size nails				
Misc. hard-ware, nuts, bolts, washers, etc.				
Gasket material: rubber, cork				
Rubber sheet 3/16" - ¼" thick can be inner tube				
Steel plate 3/16" - 1/4" thick				
Pipe joint compound or Teflon tape				
Access to metal working Facility for cutting, drilling, grinding stell plate				

HYDRAM CONSTRUCTION MATERIALS

The specific construction materials vary, and there is a range of possible adaptations and variations. At a general level, we need to know what typical sizes of standard pipe and pipefittings are available and approximately what they cost.

Please indicate: (yes or no) if the parts are generally available, i.e., one could find them readily in a plumbing supply/hardware store; if they can be specially ordered, how much time is required; approximate unit cost for the following:

PART	SIZE (DIAM)	GEN'LLY AVAILABLE	SPECIAL ORDER TIME	APPROX COST
Steel pipe, standard length_____in/cm.	3/4"			
	1"			
	2"			
Pipe Tees 	3/4"			
	1"			
	2"			
	3"			
Reducing Bushings 	2"x 1"			
	2"x 3/4"			
Sweep - 90°	1"			
45°	1"			
Female adapters	3/4"			
	1"			
Male adapters	3/4"			
	1"			

Hydram Construction Materials - continued

PART	SIZE (DIAM)	GEN'LLY AVAILABLE	SPECIAL ORDER TIME	APPROX COST
Clear PVC pipe	3"			
PVC cap	3"			
Gate valve	½"			
Foot valve	2"			
Check valve	1"			

A cement ram can also be made, reducing the need for many of the above parts, so please indicate approximate cost of cement:

$__________/________lbs.

This list is by no means all inclusive but represents key items. Detailed parts lists will be developed prior to the workshop.

SAMPLE WORKSHEET FOR FINAL MATERIALS LIST

Materials List

Type of Ram ____________
No. of Rams to be built ____

QUANTITY	DESCRIPTION	SIZE	USE

SUGGESTED SCHEDULE FOR HYDRAM WORKSHOP

Day One	Day Two	Day Three	Day Four	Day Five
Session 1 Session 2 Session 3 & 4 Theory	Sessions 3 & 4 Field Activity Session 5 Session 6	Session 7 Session 8 Session 9	Session 10 Part I, II Session 11 Session 12	Mid workshop evaluation Session 13
Day Six	**Day Seven**	**Day Eight**	**Day Nine**	**Day Ten**
Session 10, Part II - cont Session 13 - present results	Session 14 Session 15	Session 16 Session 17 Session 18	Session 10 Assemble, Operate Concrete ram	Session 19 Session 20

SCHEDULING WORKSHEET - HYDRAM WORKSHOP

CONSTRUCTION OF A PVC HYDRAM (for Demonstration Purposes) — Time: 4-5 hours

OBJECTIVE: To construct a hydram from clear PVC pipe-fittings and fabricated valves.

OVERVIEW: The PVC hydram is an excellent training tool because it enables trainees to see the hydram components moving while the ram is in operation, and to observe the directional flow of water as shown by suspended solids in the water. The PVC hydram is of limited use for actual water pumping, however, as it will last only about one month in continuous use. For this reason, it is suggested that one or more PVC hydrams be constructed prior to the workshop, and used to illustrate the introductory sessions (Session 1 & 2) on the first day of the workshop itself. The construction could be part of a pre-workshop staff training program, if desired.

MATERIALS:

- 2 1¼ tees
- 1 3/4" male adapters
- 1 1¼" cap
- 1 14"x 1¼" pipe
- 5 1¼"x 3/4" reducing bushings
- 1 24"x 3/4" pipe
- 1 1¼" coupling
- 4 ½" #6 sheet metal screws
- 2 1"x ¼" x 20 bolts
- 1 2"x ¼"x 20 bolt
- 6 ¼ x 20 nuts
- assorted washers
- Handout

PVC cleaner, PVC glue, 1/8" sheet rubber, TFE tape

TOOLS: Heat source (such as propane torch, campfire, oven) ¼-20 tap, saw, miter box, electric or hand drill, 1/8" drill bit, 13/64" drill bit, screw driver, 7/16" wrench or adjustable wrench, knife, tape measure

NOTE: This is presented in session format, in case it needs to be done with all participants, in addition to trainer preparation.

PROCEDURES	NOTES
1. Warm up the middle 12" of the 24" long 3/4" PVC pipe, making sure it is heated evenly without scorching or blistering. After PVC is pliable bend it into a 90° angle with about a 5" to 6" radius. Allow it to cool, then cut 5" off each end. (See #3 and #8 on Attachment A.	
2. Cut the 1¼" PVC into two pieces, one 12" long (#6) and one 2" long (#19), making certain that the ends are cut square and are de-burred.	
3. Cut the 1¼" coupling (#13) into two cylindrical pieces just to one side of the land. Cut of the bottom of one of the 1¼"x 3/4" reducing bushings, and sand it smooth on both sides to form a 3/8" thick PVC washer (#14). Glue the washer inside the piece of coupling without the land, flush with one end. Discard the other half of the coupling and the remainder of the bushing.	
4. To make the valves, cut two circular pieces of rubber to the same outside diameter as the 1¼" PVC pipe. Cut out of each round a horseshoe shaped piece and a ¼" hole as shown in Attachment A#7.	
5. Place four wraps of TFE tape around one end of the 2" piece of 1¼" PVC pipe. Lay on top of this one of the rubber valves you have cut out. Force this into the coupling half that has the PVC washer glued into it. Attach bolt (#12), nuts (#10) and washers (#15 & #16) as shown in Handout. Drill two 1/" holes (one on each side) through this impulse valve assembly and into the 2" piece of 1¼" PVC. Then screw two sheet metal screws into these holes (#18).	Note the 2 types of stroke adjustment illustrated in the handout. That labeled "alternate" is slight1- more complicated to but provides easier Materials required alternate stroke ad ¼ x 20 bolt and ½" wide x 2" lon cut from PVC p 2 ½" #6 sheet me

PROCEDURES - continued

NOTES

6. Cut ¼" off the bottom straight through leg of one of the tees (#1), making certain the cut is square and de-burred. Place four wraps of TFE tape around the male end of a 1¼" x 3/4" reducing bushing. Attach the 1" x ¼" bolt with nuts and washers to the remaining rubber valve as shown in the handout. Then place this rubber valve inside the bottom of the tee you just cut off. Force the TFE wrapped reducing bushing up to the rubber valve. Drill two 1/8" holes into this assembly and secure with 2 sheet metal screws.

7. Next, glue the rest of the pieces together as shown in the Attachment. Be sure to follow the instructions on the glue.

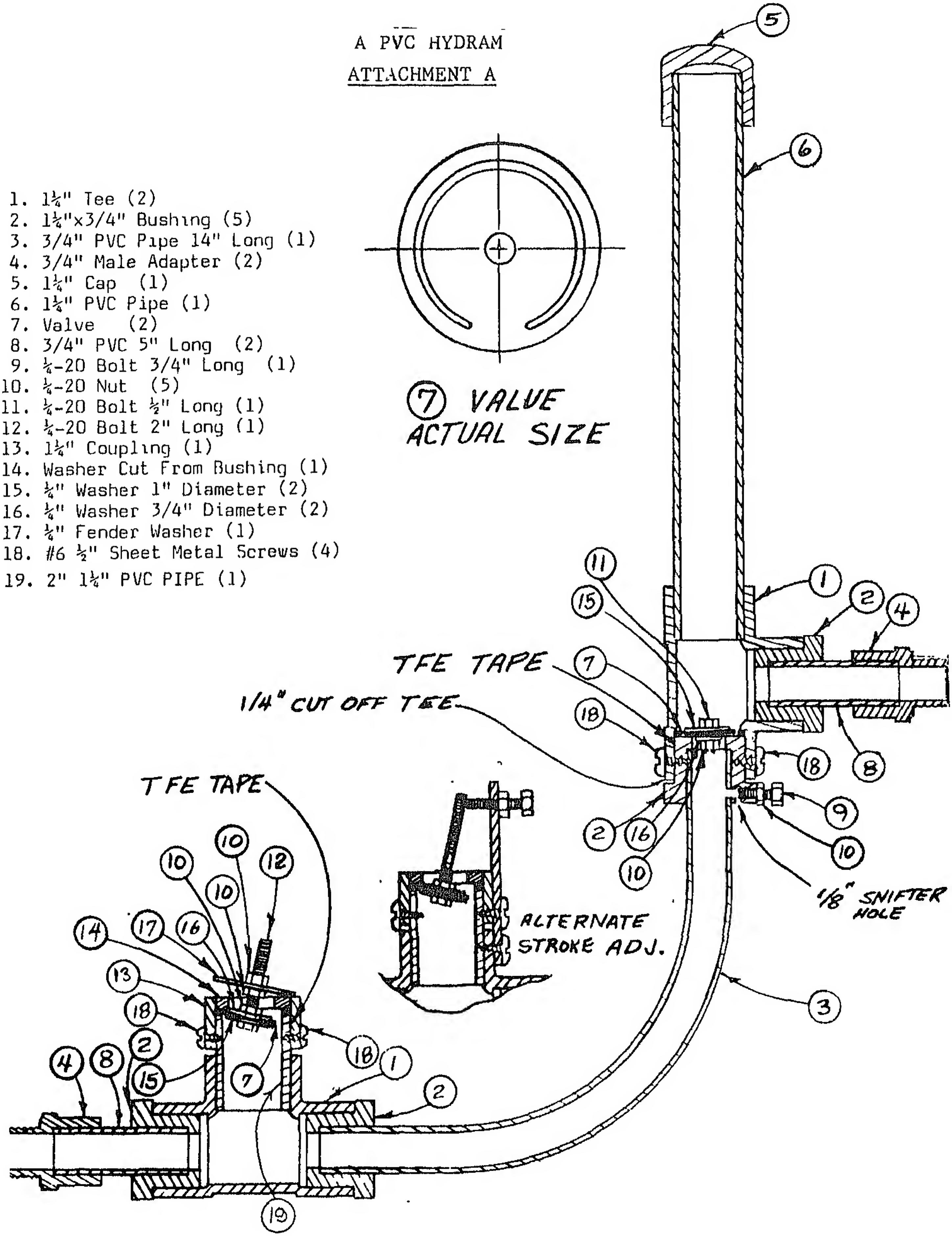
8. Drill a 13/64" hole through one of the flats on the reducing bushing just below the check valve, making certain that you also drill through the 3/4" pipe as well. Drill a 1/8" hole up from the bottom of this bushing, intersecting with the 13/64" hole. Tap the 13/64" hole with a ¼-20 tap then insert a 3/4" ¼-20 bolt with lock nut (#9 & #10).

9. After the hydram(s) have had time to dry, hook them up to a drive head and test them.

A PVC HYDRAM

ATTACHMENT A

1. 1¼" Tee (2)
2. 1¼"x3/4" Bushing (5)
3. 3/4" PVC Pipe 14" Long (1)
4. 3/4" Male Adapter (2)
5. 1¼" Cap (1)
6. 1¼" PVC Pipe (1)
7. Valve (2)
8. 3/4" PVC 5" Long (2)
9. ¼-20 Bolt 3/4" Long (1)
10. ¼-20 Nut (5)
11. ¼-20 Bolt ½" Long (1)
12. ¼-20 Bolt 2" Long (1)
13. 1¼" Coupling (1)
14. Washer Cut From Bushing (1)
15. ¼" Washer 1" Diameter (2)
16. ¼" Washer 3/4" Diameter (2)
17. ¼" Fender Washer (1)
18. #6 ½" Sheet Metal Screws (4)
19. 2" 1¼" PVC PIPE (1)



SESSION 1: INTRODUCTION TO TRAINING   Total Time: 1½ hours

OBJECTIVES: By the end of this session trainees will have

- familiarized themselves with each other and training staff; and
- identified and clarified their expectations and those of the staff.

OVERVIEW: This session is designed to establish a climate of active participation and collaborative problem-solving in the workshop. The schedule should be reviewed and discussed, and expectations need to be shared and processed.

MATERIALS:

- Handout 1A: "What's in a Name"
- Handout 1B: Workshop objectives
- Notebook or pad for each trainee (ring binder)
- Flipchart/markers or chalkboard/chalk
- Goals of workshop on a flipchart/chalkboard

Workshop Goals:

1. To design, construct, operate, maintain and repair hydrams.
2. Identify issues in hydram project plannning and implementation.

Note: "What's in a Name" is a recommended icebreaker. Trainer may use another that achieves the same objectives.

SESSION 1

PROCEDURES	NOTES
Introduction	
1. Welcome the participants to the workshop and introduce the staff. Have each staff-member say a few words about him/herself.	10 min.
2. Introduce the "What's in a Name" exercise and divide the group into small groups of 4-6 participants.	Allow 30 min. for this.
3. Distribute the handout "What's in a Name" and have the groups discuss their names using questions on the handout as a guide.	Trainer may want to join one of the groups as a participant. Be sure to give the groups a time check.
4. As a large group have the participants share some of the interesting "stories" that may have come out of their small group discussions about their names.	
Goal Setting	
5. Review goals listed on newsprint. Distribute the workshop objectives and ask participants to read them.	10 min. Participants should already have copies of the objectives. Have additional copies on hand just in case. Answer any questions.
Expectations	
6. Explain that one of the purposes of this session is to identify and clarify expectations of the training workshop.	
7. Ask the trainees to list their individual expectations of the workshop on a sheet of paper.	5 min.
8. Have the trainees form small groups of 4-5 people and ask them to share their expectations listing those they have in common on newsprint. Staff will do the same.	15 min.
9. Ask a reporter from each group to post their group's list and share it with the large group.	20 min.

PROCEDURES	NOTES
10. Clarify which expectations can be met during the workshop and those which cannot.	
11. Distribute the schedule for the workshop and discuss the first day. Explain the workshop site procedure (mealtimes, facilities, etc.).	5 min.
12. End the session by summarizing the shared expectations of the group and mention that the list will be reviewed at the end of the workshop to determine how well the expectations have been met. Ask participants to bring "Participant Site Information Worksheet" to next session.	5 min.

WHAT'S IN A NAME

Our names are one of the most distinguishing characteristics of who we are. Share with the group some of the reasons why your name is special.

Some things you might wish to share:

- Do you like your name? Why or why not?
- How did you get your first name?
- Does your name(s) have any meaning?
- What is the origin of your last name?
- Famous (or infamous) ancestors?
- Funny stories, incidents related to your name?
- Anything else you may wish to share.

HYDRAM TRAINING WORKSHOP OBJECTIVES

By the end of the training program, you will be able to:

- survey and evaluate sites for potential hydram projects;
- articulate and apply hydram theory;
- use correctly, basic water measurement techniques and formulas for proper sizing of hydrams;
- select proper ram design and size;
- develop a water source site for hydram operations;
- design water distribution system including storage tank, stand pipes, supply lines, etc.;
- construct a pipefitting and/or cement hydram;
- maintain, troubleshoot and repair hydrams;
- train local community members in the installation , operation and maintenance of hydrams; and
- identify physical, social and institutional requirements for the above.

SESSION 2

SESSION 2: INTRODUCTION TO HYDRAMS Time: 3½ hours

OBJECTIVES: By the end of this session trainees will be able to:

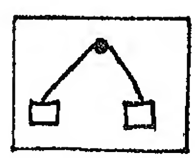
- articulate basic issues of water supply in their communities and the implications for hydram projects;
- approximate amount of water a system must deliver;
- accurately describe how hydrams work;
- articulate principles underlying how a hydram works;
- determine amount of water that can be pumped from a hydram given the flow rate and the height of the source, and the height of the delivery point; and
- use standardized notation/terms.

OVERVIEW: Part I of this session is a technical introduction to the device, providing a basic understanding of how and why it works. It presents the relationship between potential energy and the amount of flow that a hydram can deliver. Given that as a basis, trainees will follow the water flow from a source, through the ram (actual or demonstration) to a delivery point, develop an equation that describes the relationsip, and solve problems. Part II examines critical issues involved in the installation of a hydram system, including access to water, present systems, needs, use and demands for water, and establishes a context for the technical training.

MATERIALS: Handouts 2A, 2B, 2C, 2D, 2E (2A and 2B reproduced on flipchart)

A working hydram or hydram model

A physical demonstration of potential energy e.g., a pegboard with movable pegs, colored string and weights.



NOTE: Problems and examples should be written in appropriate units of measurement.

PROCEDURES | NOTES

1. Introduce session with a brief statement about the general application and history of hydrams, including use and revival in the U.S.

   NOTES: See Foreword for historical background

2. State the objectives of this session and rationale for two parts.

Part I

1. Ask for definition of potential energy. Write it on the board.

   Using attachment 2A, or a peg board, demonstrate how a falling mass can be used to lift a mass to a higher elevation.

   NOTES: Use notation consistent with handout, i.e., $E_p = m \times h$ or $E_p = w \times h$. If group seems unfamiliar with concept, the peg board will probably be better, and it should be passed around, so they can try it.

2. Refer to attachment 2B on the flip chart, and demonstrate situation in which a hydram can be used. Show how potential energy relates to the amount of water that can theoretically be pumped to a given height.

3. Point out on the diagram, the following: drive pipe, delivery head, quantity of water entering the ram, and quantity of water delivered.

   NOTES: The vocabulary and terms are important at this point; the notation is of less importance but should be introduced.

   Explain that to standardize notation all terms on drive side are capitalized, and delivery terms are in lower case, i.e.:

drive head = H	delivery head = h
water entering = Q	water delivered = q
drive pipe diameter = D	delivery pipe diameter = d
length of drive pipe = L	length of delivery pipe = l

PROCEDURES - continued

NOTES

Refer trainees to 2B for complete list, and state that for purposes at this point, it's not necessary to know all of those terms.

4. Now that the general parameters of a hydram installation are known, it is a good time to look at how a hydram works.

5. Using attachment 2C describe the water flow through various parts of the ram. Point out that the impulse valve is open when it starts. Ask questions and bring out the following:

   It might be useful to underline each part's name in a contrasting color, as you go through the description.

   - sufficient water coming into the impulse valve to close it
   - effect of water's movement being suddenly stopped ("water hammer")
   - moving through the check valve, into the accumulator
   - check valve closing, with sufficient water weight and air pressure to force water through the delivery pipe
   - vaccuum being created under the check valve, air suction, snifter

6. Go to the actual installation. Have trainees play with the impulse valve, listen to the rhythm, describe water path again, based on what's heard. Take the valve apart, ask trainees to identify key parts (impulse valve, check valve, snifter, ram body, drive pipe, delivery pipe). If possible take the ram apart, to demonstrate.

   This is easily done with a clear PVC pipe demonstration ram; which could be hooked up to an experimental stand.

7. Return to classroom. Ask 1-2 trainees to describe the movement of water and the principles. Clarify any misunderstanding, check use of terms.

   The PVC hydram could be helpful here also.

PROCEDURES - continued

8. Return to the potential energy definition, and make the analogy to amount of water pumped, using QH = qh, as a starting point. State that, because of friction and a number of other factors involved in the construction of the hydram, it's unlikely that all of the water theoretically available will or can be pumped, but that some percentage of it will be pumped. The percentage of water pumped is called the efficieny of the hydram, and is designated by 'n'. Therefore, nQH = qh. Ask the trainees to solve the equation for 'q', since the interest is in knowing how much water can be pumped.

   Result:

   $$\text{amount of water delivered} = \frac{\text{drive head} \times \text{water entering} \times \text{efficiency}}{\text{delivery head}}$$

9. Review standard units of water flow; i.e., in water flow measurement sessions, measurements are in gallons per minute (gpm).

10. Trainees now should be able to tell the amount of water that can be delivered in hypothetical situations given an assumed efficiency. Ask them to solve the following problem:

    A spring is flowing at the rate of 20 gpm. The hydram is located 20 ft. (measured vertically) below the spring. The storage tank is 100 ft above the spring (measured vertically) and the assumed efficiency of the hydram is 50%. How much water can be delivered?

    Ask one trainee to present the process and solution on the board Check the group to see if everyti is clear. Ask trainees to develo

NOTES

Or refer to efficiency as percentage of energy out; use the description that best suits the technical level of the group.

If the algebraic manipulation confuses the group, go through this derivation process:

$$nQH = qh$$

$$\frac{nQH}{h} = \frac{qh}{h}$$

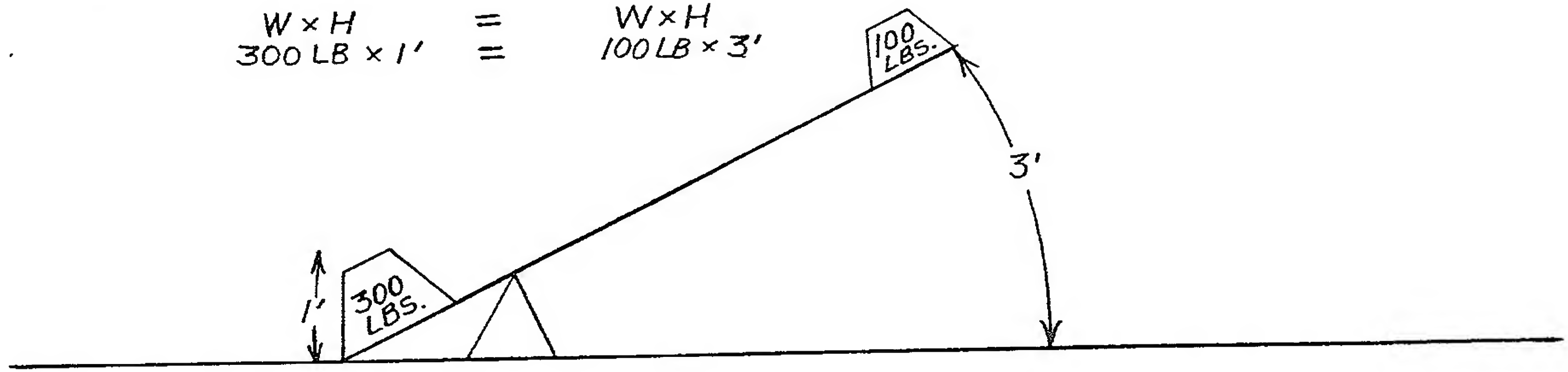
$$\frac{nQH}{h} = q$$

PROCEDURES	NOTES
other hypothetical situations for the group to solve. Check to see that the process and units are correct. If the arithmetic is wrong, continue practicing or a calculator may be used.	If participants are having problems with the arithmetic, suggest that they form study groups.
11. Wrap up by reviewing the session's objectives, and checking with the group to determine that everyone is comfortable with the concepts, vocabulary and the problem solving.	
Distribute the glossary and review key words and concepts.	
Part II	
1. Ask participants to form groups of 5-7, and assign one trainer to facilitate each group. Group Task: Distribute participant site information worksheet and have the trainees fill it out. Then as a group have them:	
a. Discuss responses to questions 1-5.	30 min.
b. List problems with present water system the hydram would solve; problems/issues that would remain the same and new problems/ issues that would be created.	15 min.
c. Each group is to select 2 major problem areas/issues in the development of the hydram system that will be critical to its success over time.	10 min.
2. Share (c) in large group. Ask for implications for their work in communities in introducing this technology.	15 min.
3. Summarize as critical issues to keep in mind as they move through the workshop.	

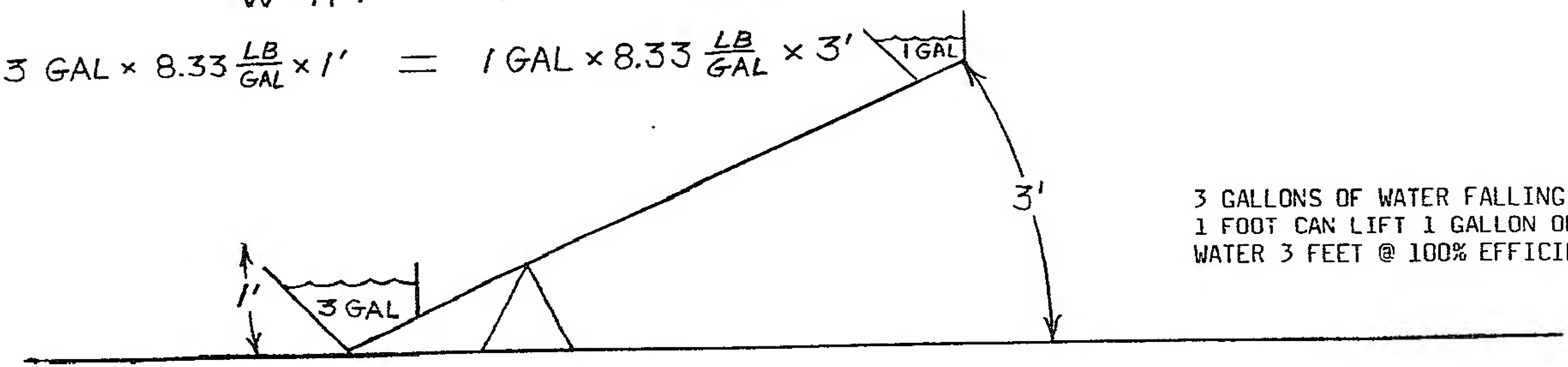
ATTACHMENT 2-A

POTENTIAL ENERGY (E_P) = MASS (M) × HEIGHT (H) ~ FOR OUR PURPOSES MASS AND WEIGHT ARE INTERCHANGABLE SO E_P = WEIGHT × HEIGHT.

$$W \times H = W \times H$$
$$300\ LB \times 1' = 100\ LB \times 3'$$

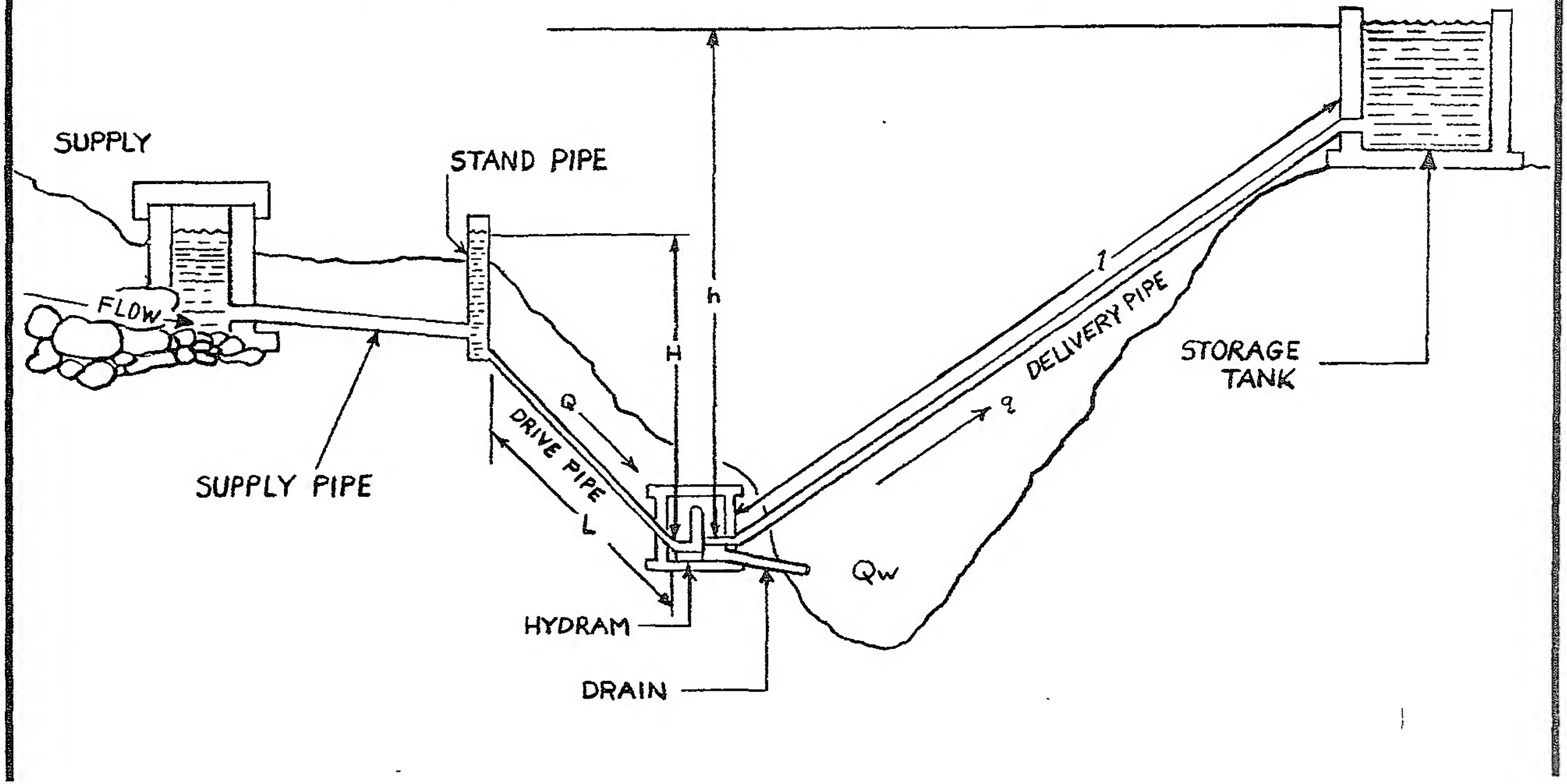


$$W \times H = W \times H$$
$$3\ GAL \times 8.33 \frac{LB}{GAL} \times 1' = 1\ GAL \times 8.33 \frac{LB}{GAL} \times 3'$$



3 GALLONS OF WATER FALLING 1 FOOT CAN LIFT 1 GALLON OF WATER 3 FEET @ 100% EFFICIENCY

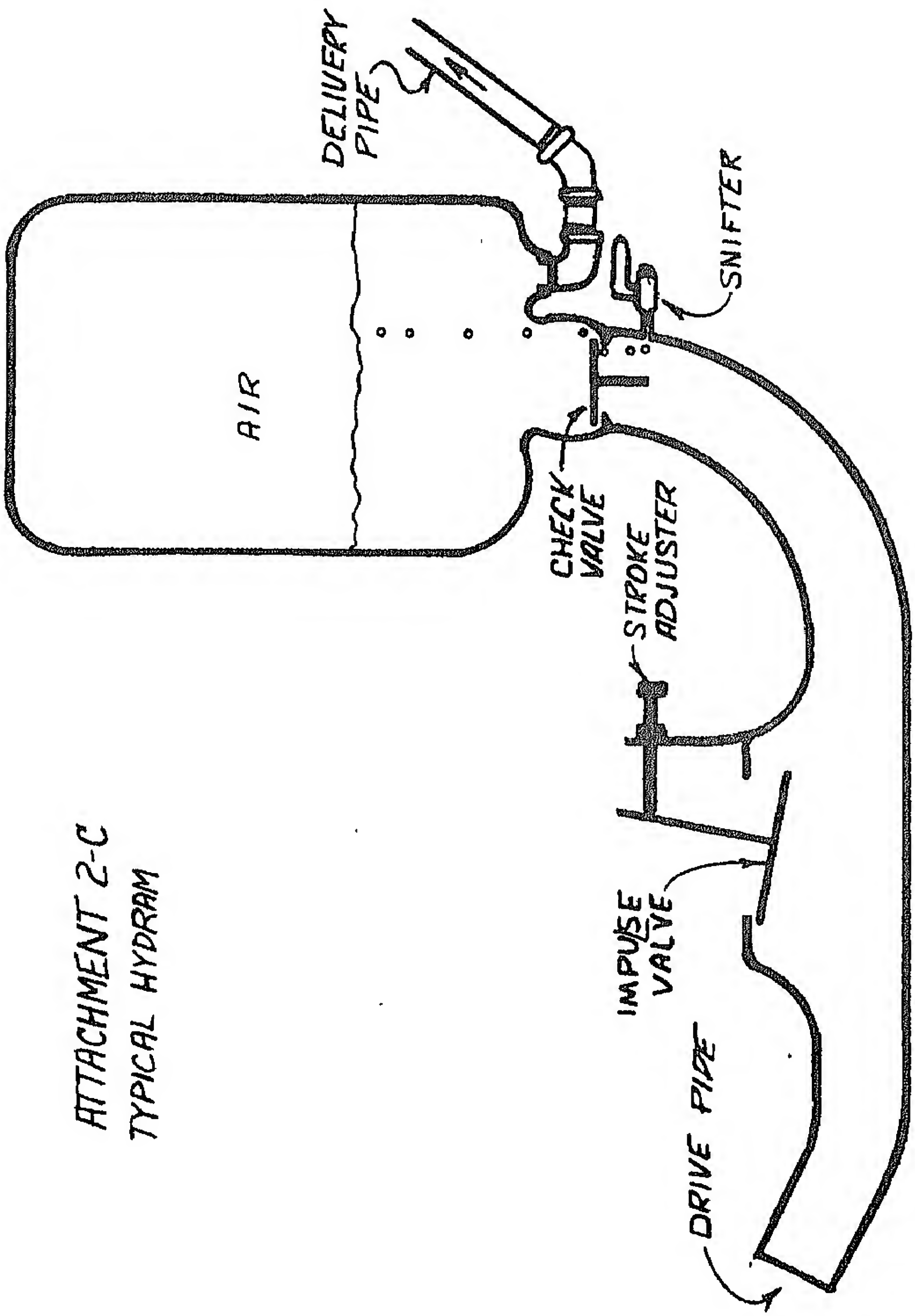
ATTACHMENT 2-B HYDRAM INSTALLATION



DEFINITION OF VARIABLES

D = Diameter of Drive Pipe	d = Diameter of Delivery Pipe
H = Head of Drive Pipe	h = Head of Delivery Pipe
L = Length of Drive Pipe	l = Length of the Delivery Pipe
Q = Quantity of Water Entering Hydram	q = Quantity of Water Delivered
	n = efficiency
Q_w = Quantity of Water Wasted from Impulse Valve	S = Length of the Impulse Valve Stroke
	F = Frequency of the Impulse Valve Stroke
	W = Weight of the Impulse Valve

ATTACHMENT 2-C
TYPICAL HYDRAM



Attachment 2-D

GLOSSARY OF TERMS FOR SESSION 2

Accumulator - (air dome) the air chamber on the hydram which cushions the water hammer, eliminating delivery pulsations and helps provide rebound.

Check Valve - (non-return valve, secondary valve, internal valve) the internal valve in the hydram that prevents the delivery head pressure from forcing water back through the hydram body.

Delivery head - the vertical distance between the hydram and the highest level of water in the storage tank that the hydram is pumping to.

Delivery pipe - the pipe which connects the output of the hydram to the storage tank.

Drive head - the vertical distance between the hydram and the highest level of water in the supply system.

Drive pipe - a rigid pipe usually made of galvanized steel that connects the hydram to the source reservoir or stand pipe.

Efficiency - (n) the ratio of the energy input to the energy output; a measure of how well a hydram functions;

$$n = \frac{qh}{QH}$$

Frequency - (f) the number of times a hydram cycles in one minute.

Hydram - (hydraulic ram, hydraulic ram pump, automatic hydraulic ram pump, ram) an ingenious device that uses the force of water falling through a drive pipe to pump water to a height greater than its source, making use of hydraulic principles and requiring no fuel.

Impulse Valve - (clack valve, out-side valve, impetus valve, waste valve) the valve on the hydram that creates and controls the water hammer.

Potential energy - energy derived from position or height; is equal to the height that a mass can fall times its weight.

Rebound - the flow of water in the ram reversing direction due to the air pressure in the accumulator, closing the check valve.

Settling basin - a small tank usually made of steel or concrete that is used in place of a stand pipe in an installation where additional settling is necessary.

Snifter valve - (air valve, spit valve) the small valve just below the check valve that allows air to enter the hydram.

Spring box - a concrete box built around a spring to facilitate water collection and to protect the water source from surface contaminates.

Stand pipe - an open-ended, vertical pipe sometimes used at the beginning of the drive pipe.

Supply pipe - everything in a hydram system before the drive pipe, usually including some but not necessarily all of the following; spring box, supply pipe, stand pipe, settling basin.

Waste water - (Q_w) the water coming out of the impulse valve and the snifter.

Water delivered - (q) the rate at which water is delivered to the storage tank;

$$q = \frac{Q \times H \times n}{h}$$

Water flow to the hydram - (Q) all the water used by a hydram which is equal to the waste water (Q_w) plus the water delivered (q).

Water hammer - the effect created when water flowing through a pipe is suddenly stopped. In a hydram this causes the closing of the impulse valve and opening of check valve.

HYDRAM TRAINING WORKSHOP
PARTICIPANT SITE INFORMATION

Hydram installations are extremely site specific. Although it's a simple technology, it does require being properly designed and sized based upon particular characteristics of the site. It also requires a certain amount of follow-up and maintenance. In order to maximize your learning during the workshop, please begin to gather the following information. (You don't have to have all of the information prior to the workshop, but it will help if you begin to consider these factors at your site.)

1. What water sources are available?

2. What kinds of water systems are presently being used? Who is responsible for maintaining the systems?

3. What are the present patterns of water use in your community? (e.g. potable water, irrigating home garden plots)

4. What is the proposed purpose for the hydram installation?

5. What kinds of skills and resources are presently available to support a hydram installation?

   - Community history of cooperative work on projects?

   - As existing community water distribution system?

   - Facilities and craftspeople in or near the community with metalworking, plumbing, and masonry capabilities? Vocational-technical schools, public works?

6. How do you rate your present knowledge/experience about water systems, pumps, hydrams? What do you need to refresh, what do you need to know?

7. If you have a site in mind for a hydram, can you find out:

   a. approximate flow rate of the water source (gallons/minute)

   b. approximate "drive head," i.e., vertical distance from water source to where hydram will be installed?

   c. approximate "delivery head," i.e., vertical pumping distance from ram to point of delivery?

   d. amount of water desired/required? (gallons/day)

   NOTE: During the workshop, you will learn simple measuring techniques; knowing this information beforehand allows one to design a site specific ram during the workshop with guidance from the training staff.

Please bring this sheet with you to the workshop. If it's easier to sketch your situation, feel free to do so.

SESSION 3

SESSION 3: WATER MEASUREMENT TECHNIQUES Total Time: 3 hours

OBJECTIVE: By the end of the session, the trainees will be able to accurately measure the flow rate of moving bodies of water using a weir, a bucket and watch, or the float method.

OVERVIEW: It is important during this session that the trainees gain experience in estimating flow rates and develop skills in measuring flow rates. Three methods of measurement shall be presented: 1) the weir method, 2) the bucket and stop watch method, and 3) the float method. Each method will entail "hands on" work, constructing a weir, channelling the stream, placing stakes in the stream, etc. The findings from these three methods will be compared.

MATERIALS: Handouts 3A - 3D
lumber, nails, approximately 3' of pipe with a sufficient diameter for the expected flow, sheet metal (optional), bottle with cork, or float. Have a set of materials for each team.

TOOLS: watch with a seconds function, bucket of known capacity, saw, level, tape measure, hammer, pick or mattock, tin snips (optional), have one set of tools for each team.

*TRAINERS NOTE:

1) Since the purpose of the activity is to learn to measure, not build, pre-construction of site levels, weirs is recommended.

2) The weir table is provided in both English and metric units;

3) the float method has limited applicability. Decide whether or not to spend time conducting the field activity.

4) Identify site for field activity ahead of time, ensuring enough locations for small groups or pairs to work independently; stake out distances if necessary.

PROCEDURES	NOTES
1. Discuss the need for water measurement in hydram systems: - amount of water delivered - amount of water into ram	
2. State objectives for the session.	
3. Ask participants to approximate amount of water needed for: - irrigating an average garden - domestic use - potable water	
4. For each, ask participants to compute amount of water needed to enter the ram given H=10', h=30'.	This problem links and revie Session 2.
5. Distribute the handouts and make a transition to the task of measureing water available.	
6. Describe the weir and what it is used for.	
7. Describe how to build and install a weir. 8. Explain how to use the weir table.	A desk top model would work well for this and could substitute for the real exercise if time and facilities aren't available.
9. Go over the example in the handout and make certain everyone feels comfortable with their ability to use the weir table.	
10. Describe how to use the bucket and watch method. 11. Describe the float method of measurement.	Use discretion as to how much detail to go into as this method is used on flows that would be considered infinite with a ram installation. (float method)
12. Explain steps in determining cross-sectional area of a stream.	
13. Explain procedures in determining the velocity of the stream.	

PROCEDURES	NOTES
14. Go over the example in the handout.	
15. With the trainees, go over the sequence of events involved in the remainder of this session and how much time is left.	
16. Divide the trainees into groups of three or four, giving each group an even level of total skills.	
17. Proceed to the creek or stream.	
18. Locate a section along the creek or stream where the flow is consistent and there is sufficient room for all the groups to work within sight of each other.	
19. Have each group select a site which they feel will be easily developed.	
20. Have each trainee make a guess as to flow rate of the creek or stream they are measuring.	
21. Note estimates of flow rate.	
22. Calculate flow rate by the float method.	Use only if time allows and the water source is appropriate.
23. Select appropriate section of the stream or creek and determine cross-sectional area.	
24. Place two stakes in stream at appropriate spots and distance from each other.	
25. Place float in mid-stream and measure time it takes for float to travel from one stake to another.	
26. Repeat measurement several times and average the flow rate.	

PROCEDURES - continued

NOTES

27. Note differences between original estimates and measurements of flow rates.

28. From the measurements made, have each group decide on the size of their weir notch.

29. The trainees next construct their weirs and install them in the creek, making certain that the weirs are well supported and sealed against leakage around the bottom and sides.

It may be a good idea to have each group build their weir out of different materials so that the construction techniques can be compared.

30. After the weirs are constructed, readings should be taken periodically while the water is seeking its new level and while flow rates are being interrupted by the other weir installations. Once the readings become consistent, they should be considered reliable.

31. Using the weirs as partial dams, install the short lengths of pipe and seal around them in the same manner that the weirs were sealed.

32. With all the water flowing through the pipe and into the bucket, time how long it takes to fill the bucket. Again readings should not be considered reliable until they are consistent.

33. At this point, review what has been done thus far in the session.

34. Back at the classroom, list the readings from each group and discuss the reasons for the variations. If different materials were used for the weirs, discuss the advantages and disadvantages of each.

Point out need to measure seasonal variations of water flow

35. Ask participants which method they would use, given resources at their site.

HANDOUT 3A

USING A WEIR

A weir may be defined as an overflow structure built across an open channel, usually to measure the rate of flow of water. Weirs are acceptable measuring devices because, for a weir of a specific size and shape (installed under proper conditions) only one depth of water can exist in the upstream pool for a given discharge. The discharge rates are determined by measuring the vertical distance from the crest of the overflow portion of the weir to the water surface in the pool upstream from the crest, and referring to tables which apply to the size and shape of the weir. For standard tables to apply, the weir must have a regular shape, definite dimensions, and be set in a bulkhead and pool of adequate size so the system performs in a standard manner.

Whenever the flow from a creek is too great to be measured in a bucket and yet is small enough to be dammed by a board, the weir method of measurement should be used.

Determine the dimensions to be used for the weir notch. The width of this notch is related to the measurement of the flow rate by the height of the water in the pool formed behind the weir. This height is measured in inches and by using a weir table, the inches can be converted to gallons per minute. A number of notches of different widths and height can accommodate a stream's flow. A rule of thumb is to make the width of the notch 3 times the height.

From your estimate of the flow of the stream, look at the weir table and guesstimate what size notch will accommodate your flow. Keep in mind that the whole stream must pass over the notch and that the pool formed behind the weir should become deep enough for you to easily get a decent height measurement, i.e., 2½" vis a vis 1/16". Example: you estimate the stream is flowing at 150 gal/min. If you made a notch 12" wide and 4" high, at full flow this weir would read approximately 290 gal/min. (4"-- 23.936 gal/min. x 12" = 286.89 gal/min). This weir would fit your stream if an actual weir reading of 2½" water height were obtained, it would indicate a flow rate of 11.818 gal/min/inch of notch or 141.8 gal/min (11.818 x 12") for the stream.

Once you have determined the dimension of the notch, cut the notch in the board and place the weir board in the stream making certain that it is kept level and seal off the stream completely. Support it with stakes and large rocks.

Measure 2 feet upstream from the weir board and drive a stake. Using a level, put a mark on the stake even with the top of the weir board. Next, measure down from this mark to the water level, subtract this measurement from the depth of your notch and that will give you the height of the water level above the bottom of the weir notch.

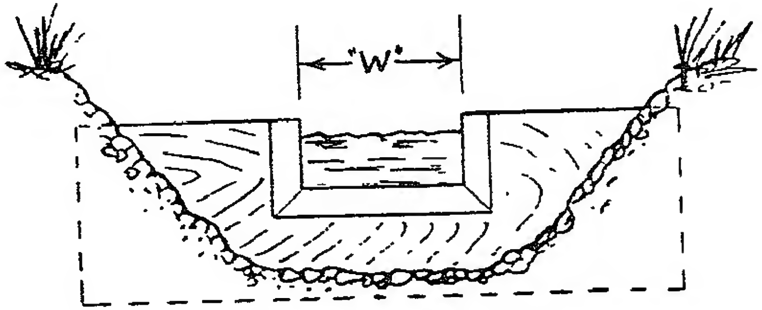
Using the weir table attached, locate the integer on the left hand column and the fraction on the top column. Where these two rows intersect is the amount of gallons per minute flowing past the weir for every inch of width. Next multiply this figure by the width and this gives you the total flow of the creek.

Example:

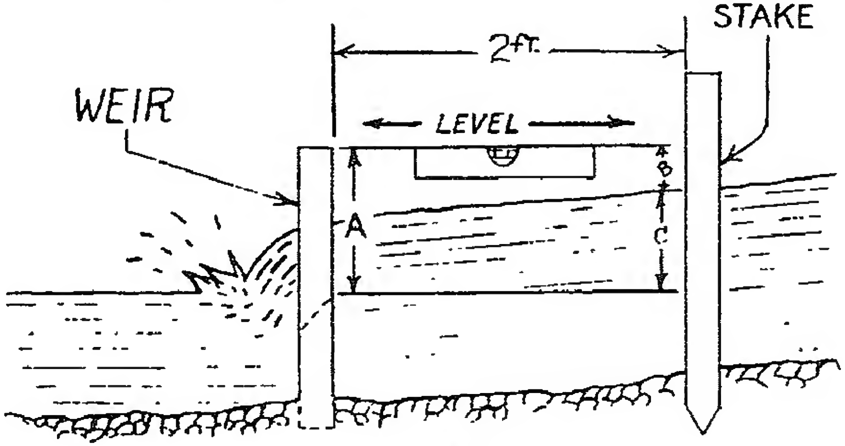
Water is flowing through a creek three feet wide and about 3 inches deep. It looks like about 30 gallons per minute. After looking at the weir table we decide that a notch 6" wide and 2" deep would probably work. After cutting the notch in a 4 foot 1x6 piece of lumber, the weir board was placed in the stream. Two feet upstream a stake is driven in the water in front of the notch. A level is used to place a mark on the stake level with the top of the weir board. The water level is then measured to be ½" down from this mark.

We now know by subtracting this measurement from the depth of the notch that the water level is 1½" above the bottom of the notch. Now looking at the weir table we find 1 on the left hand column and ½ on the top row. These two rows meet at 5.46. We multiply this by the width of the notch (6") to find that the flow rate was 32.76 gallons per minute.

USING A "WEIR" TO MEASURE LARGE QUANTITIES OF WATER

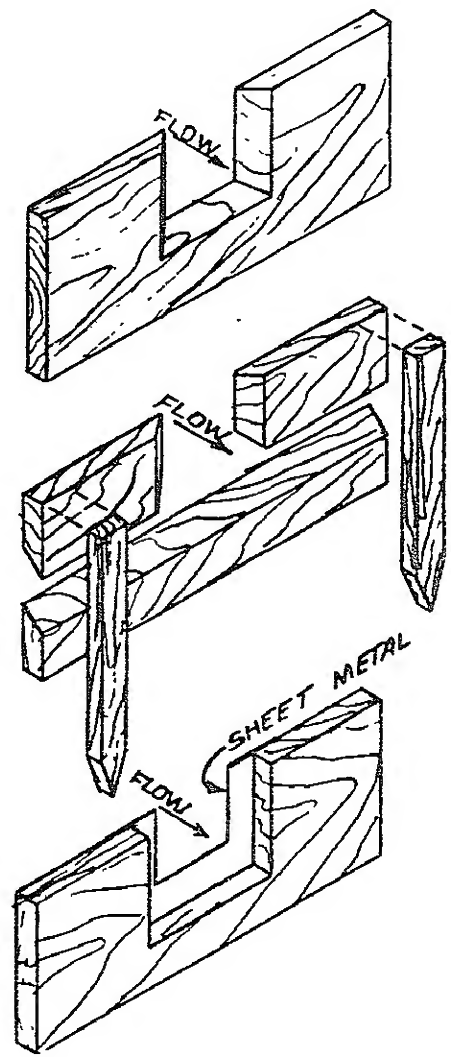


THE "WEIR" IN THE STREAMBED



"A" MINUS "B" EQUALS "C"

"C" = The depth of water above the bottom of the Weir.



3-B Using a weir

Height of water above weir notch in inches

	0	1/8	1/4	3/8	1/2	5/8	3/4	7/8
0	000	.0748	.374	.673	1.047	1.421	1.945	2.394
1	2.992	3.516	4.114	4.787	5.46	6.134	6.882	7.63
2	8.452	9.2	10.098	10.92	11.818	12.716	13.614	14.586
3	15.484	16.531	17.503	18.55	19.523	20.645	21.692	22.814
4	23.936	25.058	26.18	27.377	28.499	29.696	30.967	32.164
5	33.436	34.707	35.979	37.25	38.522	39.868	41/215	42.561
6	43.908	45.329	46.75	48.171	49.518	51.014	52/435	53.931
7	55.352	56.848	58.344	59.915	61.411	62.982	64.552	66.048
8	67.694	69.265	70.836	72.481	74.127	75.772	77.418	79.064
9	80.784	82.504	84.15	85.87	87.591	89.311	91.032	92.827
10	94.547	96.342	98.138	99.933	101.73	103.6	105.393	107.263

3-C Weir table

Flow rate per inch of weir notch in gal/min.

	0	3.2	6.35	9.5	12.7	15.9	19.	22.2
0	0	.283	1.415	2.547	3.963	5.379	7.362	9.062
25.4	11.3	13.3	15.573	18.12	20.668	23.219	26.051	28.882
50.8	31.994	34.825	38.225	41.336	44.735	48.135	51.534	55.214
76.2	58.613	62.577	66.256	70.219	73.902	78.150	82.113	83.332
101.6	90.608	94.855	99.102	103.633	107.88	112.412	117.223	121.754
127	126.57	131.380	136.195	141.007	145.822	150.913	156.016	161.111
152.9	166.21	171.589	176.968	182.347	187.446	193.109	198.488	204.151
177.8	209.53	215.193	220.856	226.803	232.466	238.413	244.356	250.019
203.2	256.25	262.197	268.143	274.37	280.601	286.828	293.059	299.29
228.6	305.8	312.312	318.542	325.053	331.568	338.08	344.594	351.388
254	357.899	364.694	371.493	378.288	385.09	392.169	398.956	406.035

3-C Weir table

Flow rate per millimeter of weir notch in liters/min.

METRIC

HANDOUT 3D

THE FLOAT METHOD OF MEASUREMENT

The float method of measurement is a simple procedure for obtaining a rough estimate of the flow of the stream. It will give a ball park figure for looking at the stream's potential. It should not be used for final determination of the hydram system to be used unless the flow rate needed for the ram is such a small percentage of the stream's total flow that what's taken from the stream, for all practical purposes, amounts to a minimal portion of the stream.

The float method is based upon two aspects of the stream: it's cross-sectional area and the velocity of the stream. The cross-sectional area should be determined at some accessible spot in the stream, preferably in the middle of a straight run. Measure the width (w) of the stream. Then, using a stick, measure the depth at equal intervals across the width of the stream (see figure below). Record the depth at each interval and calculate the average depth (d). Now multiply the width (w) by the average depth (d) to get the cross-sectional area (A).

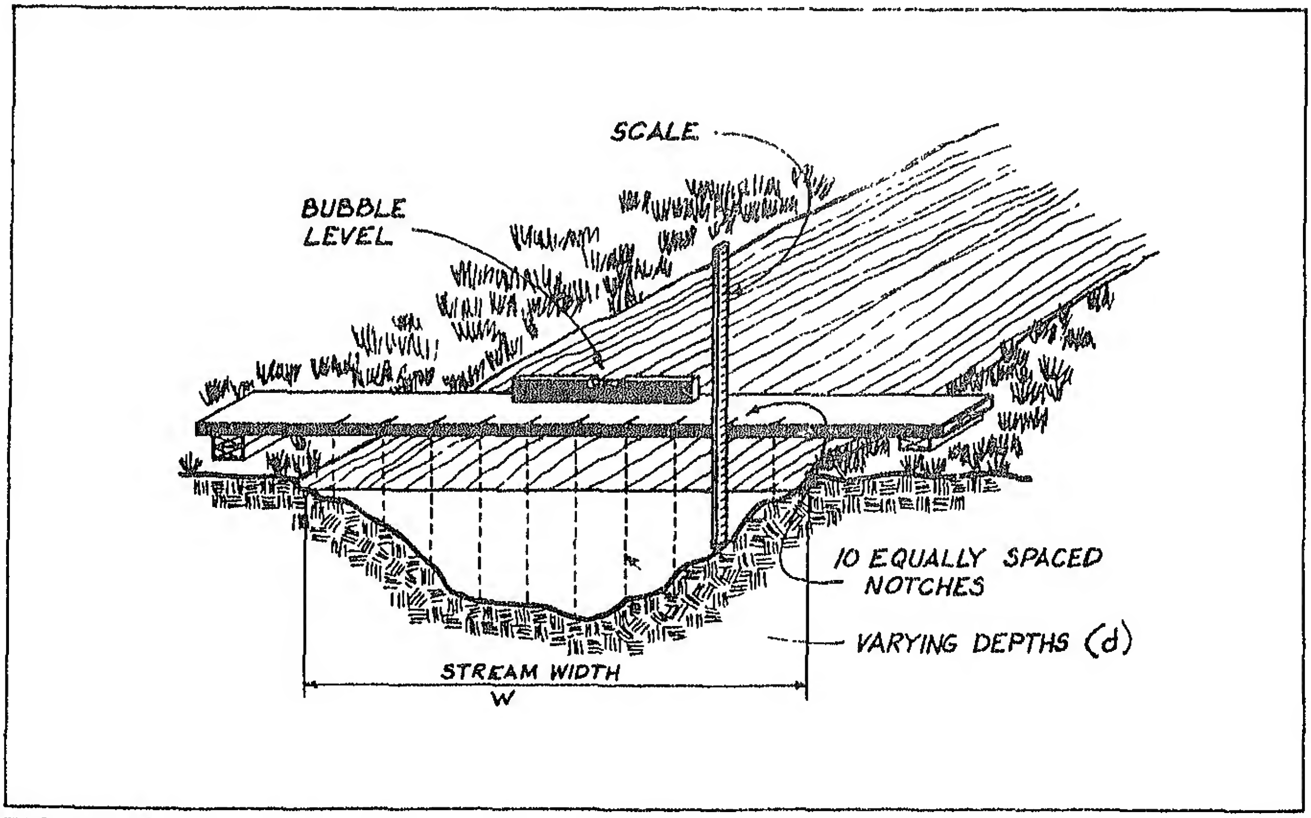


FIGURE A

Example: The width of a stream, at the point of making depth measurements, is 4 feet. The average depth is 1.1 feet. Therefore, the cross-sectional area (A) is:

$$A = w \times d$$
$$A = 4 \text{ feet} \times 1.1 \text{ feet}$$
$$A = 4.4 \text{ square feet}$$

The stream velocity can be determined by choosing a straight stretch of water at least 30 feet long with the sides approximately parallel and the bed unobstructed by rocks, branches or other obstacles. Mark off points along the stream. On a windless day, place something that floats in midstream, upstream of the first marker. A capped bottle partially filled with water works well because it lies with a portion of the bottle submerged and doesn't just ride the surface of the water. Carefully time the number of seconds it takes the float to pass from the first marker to the second. Repeat this process several times and average the results.

Example: The average time for a float to travel between two markers placed 30 feet apart is 30 seconds. The velocity (V) of the float is therefore:

$$V = \frac{30 \text{ feet}}{30 \text{ seconds}}$$
$$V = 1 \text{ foot/second}$$
$$V = 60 \text{ feet/minute}$$

The flow rate of the stream can now be calculated by multiplying the cross-sectional area (A) by the stream velocity (V). The usable flow (F) can then be determined by multiplying the stream flow rate by a fraction representing the portion of the stream flow that you can or want to use.

Example: If you will be using 25% of the stream flow, the usable flow (F) is:

$$F = A \times V \times .25$$
$$F = 4.4 \text{ square feet} \times 60 \text{ feet/minute} \times .25$$
$$F = 66 \text{ cubic feet per minute}$$

This flow in cubic feet per minute can then be converted to the appropriate units by multiplying by the correct conversion factor

cubic feet/min x 7.48 = gallons/min
cubic feet/min x 28.3 = liters/min

SOURCE: Micro-Hydro Power, National Center for Appropriate Technology (1979).

SESSION 4: MEASURING HEADS AND DISTANCE Total Time: 2-4 hours

OBJECTIVE: By the end of this session the trainees will have demonstrated skills in measuring heads by using sight levels, hose levels, pressure gauges, and in measuring distances using their stride and sight levels.

OVERVIEW: At a potential hydram site trainees will perform a series of measurement procedures for determining the head of a stream/spring, using sight levels, hose levels and pressure gauges (where applicable). In addition trainees will measure the distance from the point where water will be taken from the stream/creek to where the ram will be installed using tape measures and their stride.

MATERIALS:
- Handouts 4A - 4E
- 15 ft of 1x2 lumber (or something similar which is straight) and string.

TOOLS:
- sight levels: 1 per pair of trainees; calibrated before session
- tape measures
- clear hose or tubing
- pressure gauges

*TRAINERS NOTES:

1. Distances and heads for trainee practice must be identified and measured ahead of time.
2. 3-4-5 triangle sight level should be pre-cut, since purpose of this activity is to measure not construct.
3. Pre-construction of site levels, weirs is recommended.
4. Time and available materials may make some techniques impractical. Select techniques ahead of time.

PROCEDURES	NOTES
1. Distribute the handouts and go over the objective of the session.	
2. Describe the total activity and the techniques the trainees will be using.	
3. Divide the trainees into pairs making certain the total competency of each group is about the same.	
Part I: Head Measurement	
1. Start by demonstrating how to calibrate sight level and then have the trainees calibrate their sight levels and measure the height of their eyes.	
2. Give the trainees the task of measuring the drive head and the delivery head of either an existing or a future hydram using a sight level.	
3. The trainees should next compare measurements and any measurements that seem out of line should be rechecked along with the sight level calibrations.	
4. The trainees should build sight level from indigenous materials using a 6 foot, 5 ft., and a 4 ft. 1 x 2, nails, string, and a rock. The three boards should be nailed together to form a right triangle. The string is attached to the 90° corner of the triangle with the rock attached to the other end (see handout 4C). With the triangle held so the string remains parallel to the longer leg, one can sight down the shorter leg perfectly horizontally. These indigenous sight levels are now used to measure the same heads.	It may be best to simply describe how this simple sight level works. If necessary to construct, traine should pre-cut lumber.
5. Measure the same head using a clear plastic hose or tube filled with water with one end of the hose attached to a stick of known length (see Handout 4D).	This is a very accurate technique, but cumbersome to practice.

PROCEDURES

6. If there is a hydram installed at the site, attach a pressure gauge to the drive and delivery side and give the trainees the task of calculating the heads from the pressure readings. If this is a potential storage tank to the hydram site, then fill the pipe with water and attach a pressure gauge. Pressure readings should be taken and the delivery head calculated.

7. If the sight levels are of the kind that have more than one horizontal cross hair, explain to the trainees how to use these levels for distance measuring.

8. With the help of their partner, each trainee will measure ten normal paces using the tape measure and then divide by ten to determine their pace.

9. Give the trainees the task of measuring a distance using their pace.

10. Have them then measure a distance using a tape measure; compare the two measurements.

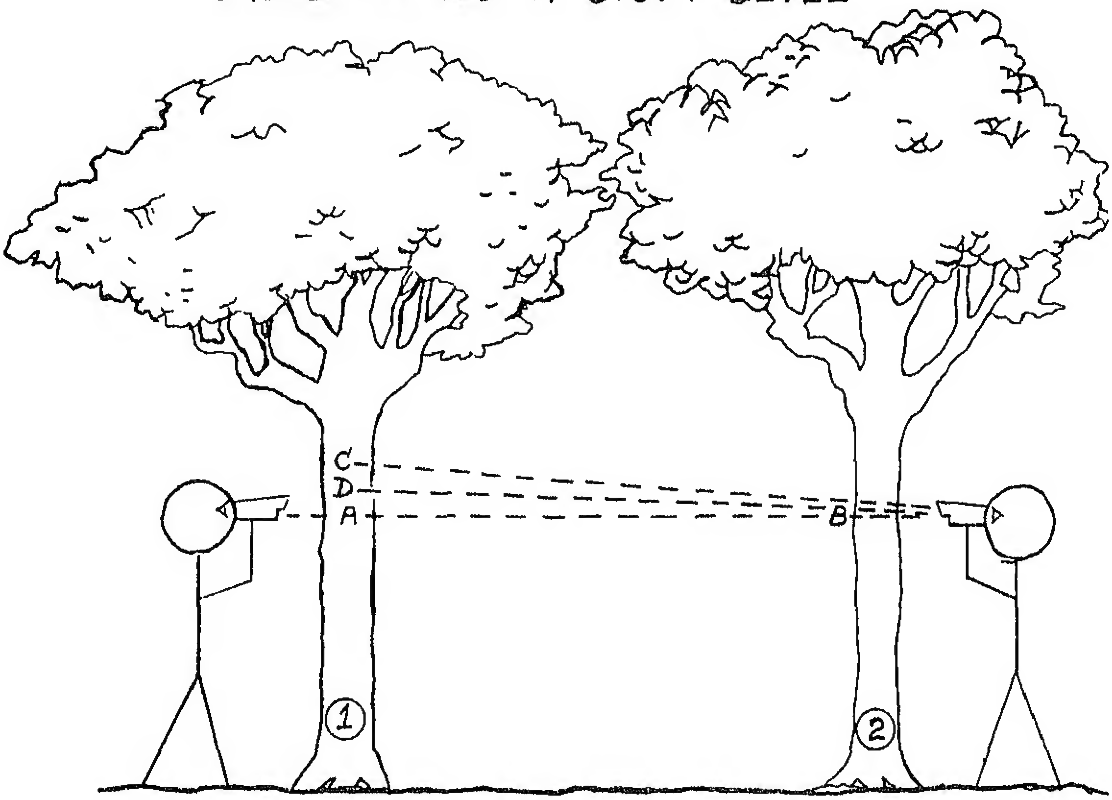
11. The groups should then be given a task of measuring the drive and/or the delivery pipe distance.

12. Back in the classroom, discuss any variations of the readings taken and the degree of accuracy that can be expected with each method used.

NOTES

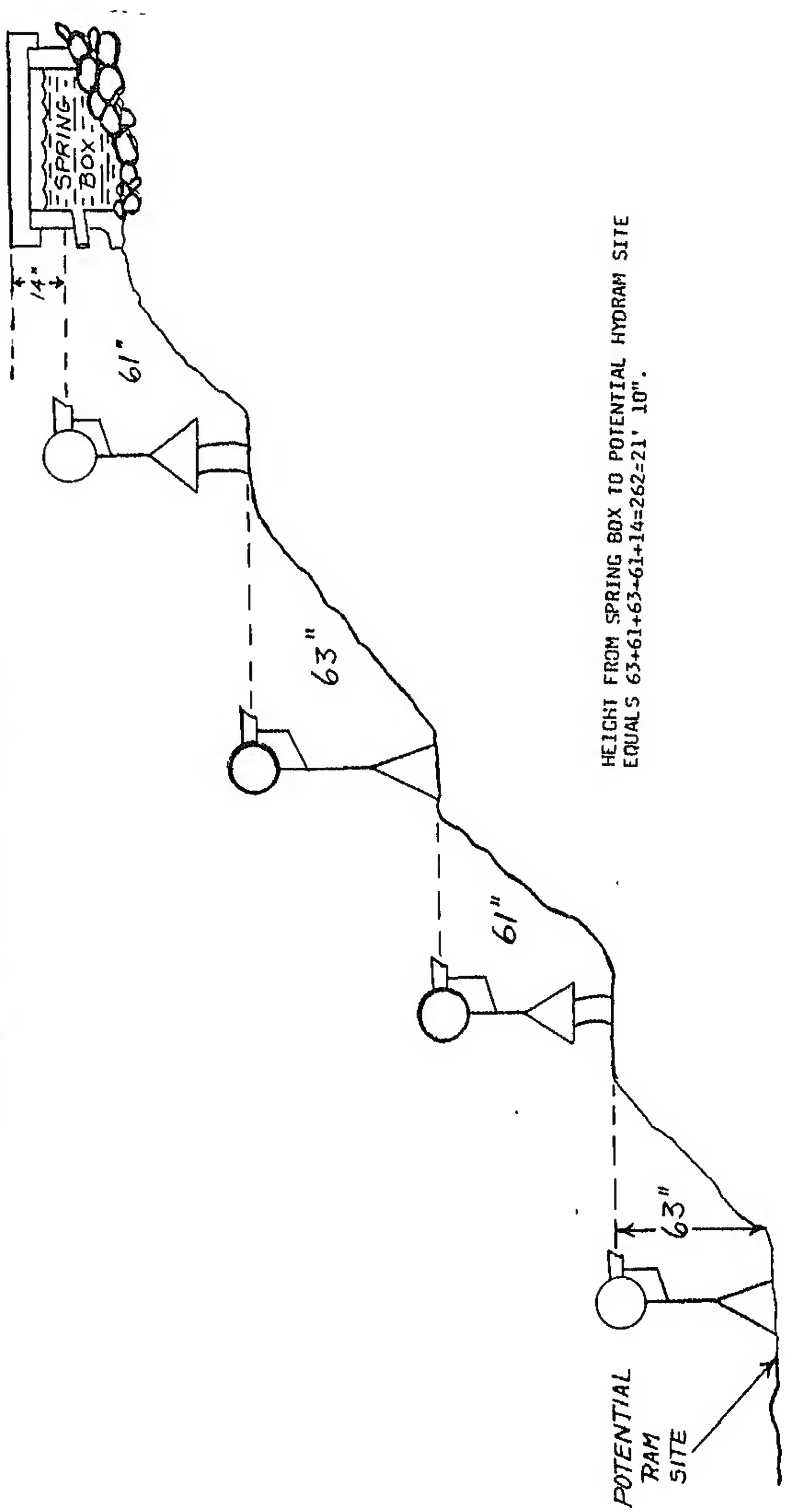
ATTACHMENT 4-A

CALIBRATING A SIGHT LEVEL



TO FIND OUT IF THE SIGHT LEVEL NEEDS TO BE CALIBRATED, SIGHT FROM POINT "A" ON TREE (OF OBJECT #ONE) TO TREE (OBJECT #TWO) AND MAKE A MARK, POINT "B". THEN SIGHT FROM POINT "B" BACK TO ORIGINAL TREE (OBJECT #ONE) AND MAKE A MARK AT THIS POINT "C". IF THE SIGHT LEVEL IS PROPERLY CALIBRATED POINTS "A" AND "C" SHOULD BE THE SAME AND AT THE SAME LEVEL AS POINT "B". IF THEY ARE DIFFERENT, THE POINT MIDWAY BETWEEN "A" AND "C" (POINT "D") SHOULD BE LEVEL WITH "B". CALIBRATE YOUR SIGHT LEVEL TO THIS LINE.

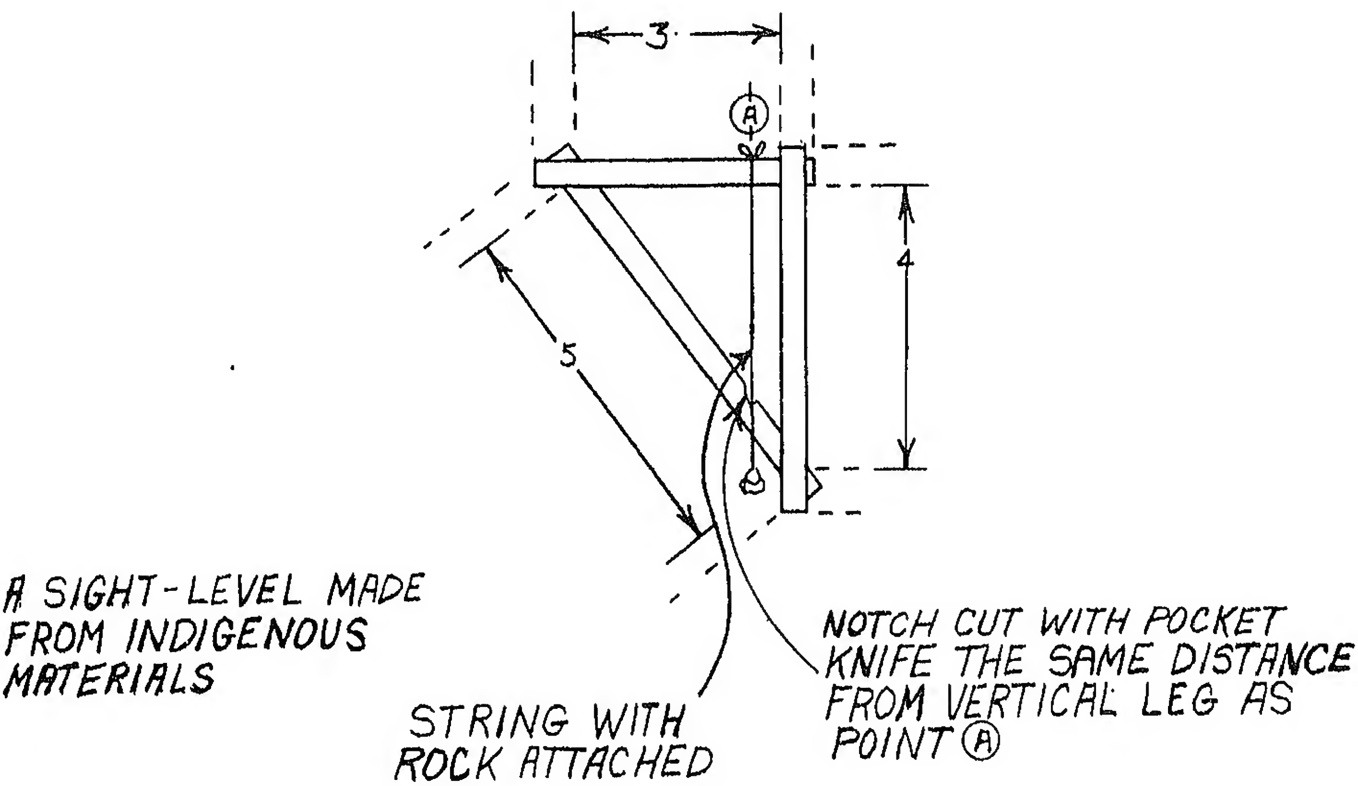
ATTACHMENT 4-B
USING A SIGHT LEVEL

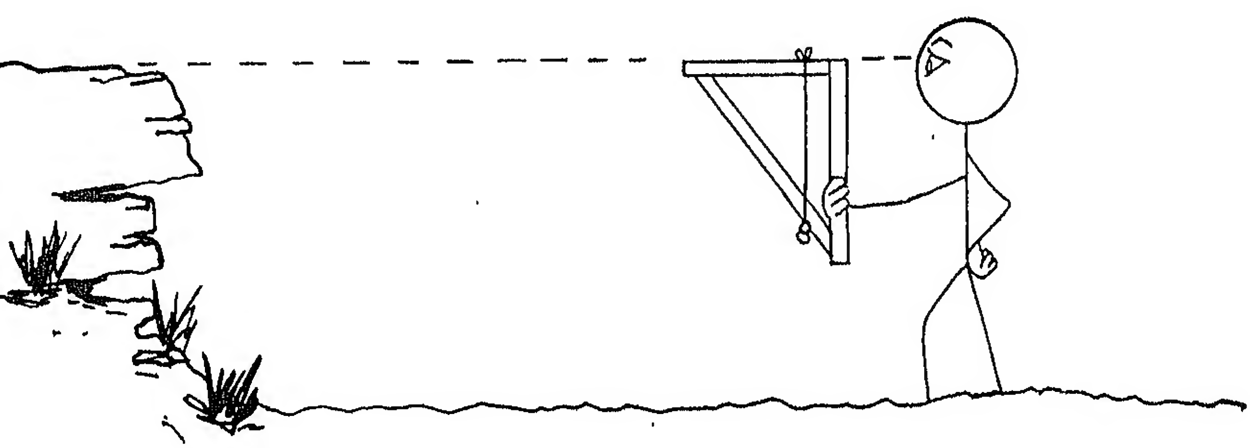


HEIGHT FROM SPRING BOX TO POTENTIAL HYDRAM SITE EQUALS 63+61+63+61+14=262=21' 10".

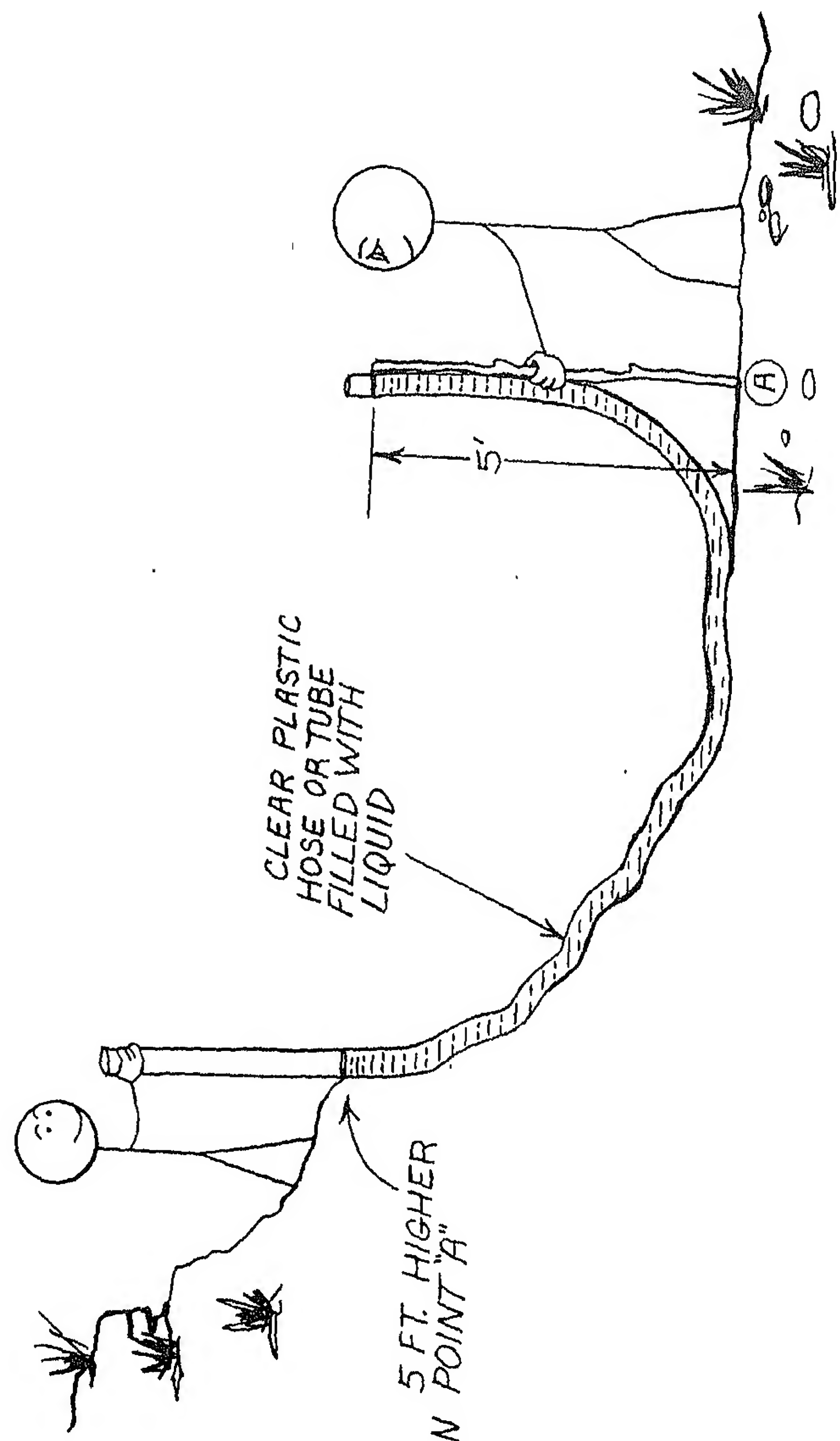
ATTACHMENT 4-C

ALTERNATE WAYS OF MEASURING HEADS





ATTACHMENT 4-D
ALTERNATE WAYS OF MEASURING HEADS



Session 4
Handout 4E

DISTANCE AND HEAD MEASUREMENT WORKSHEET

	COURSE 1				COURSE 2				COURSE 3				WATER		
	DISTANCE	M	HEAD	M	DISTANCE	M	HEAD	M	DISTANCE	M	HEAD	M	BUCKET	FLOAT	WEIR
SUBGROUP A															
small group 1		Ta		S		C		H		P		Tr			
small group 2		C		H		P		Tr		Ta		S			
small group 3		P		Tr		Ta		S		C		H			
SUBGROUP B															
small group 1		Ta		S		C		H		P		Tr			
small group 2		C		H		P		Tr		Ta		S			
small group 3		P		Tr		Ta		S		C		H			
SUBGROUP C															
small group 1		Ta		S		C		H		P		Tr			
small group 2		C		H		P		Tr		Ta		S			
small group 3		P		Tr		Ta		S		C		H			

Method = M

Distance: Tape = Ta
Cord = C
Pace = P

Head: Sight = S
Hose = H
Triangle = Tr

SESSION 5

SESSION 5: REVIEW EXERCISE #1 — Total Time: 2 hours

OBJECTIVES: By the end of this session trainees will have described how a hydram works, in their own words, solved review problems independently and clarified any misunderstandings to date.

OVERVIEW: This session provides an opportunity for participants to review and synthesize material to date.

MATERIALS: Handout 5A
Pencil, paper
Chalkboard/chalk or flipchart/markers

PROCEDURES	NOTES
1. Encourage questions on any information that has been presented thus far and try to get trainees to answer for each other.	30 min.
2. Distribute the review exercise, and ask individuals to complete it on their own.	30 min.
3. After everyone has completed the review exercise, have them discuss answers with one other person.	20 min.
4. Ask for volunteers to share answers to individual problems.	30 min.

Handout 5A: Review Exercise 1

Name: ____________________

1. How does a Hydram work? ____________________

2. In a hydram installation where the hydram is located 20 feet below the spring box, how much water could be pumped in a day to a storage tank 100 feet above the springs' box if the spring is flowing 10 gpm and the hydram efficiency is 50%? ____________________

3. What is the flow rate in gpm through a weir, four inches wide, when the water level is 5 3/8" above the bottom of the weir slot when measured two feet upstream? ____________________

4. What is the height of your eye level? ____________________

5. What is the length of your pace? ____________________

Answers to Review Exercise #1

1. The hydram is located below the source of water and is used to pump the water to a storage tank which is higher than the source. The water accelerates as it flows down hill through the drive pipe and out the impulse valve until it reaches such a velocity as to slam the impulse valve shut. This causes a water hammer effect, forcing water and a few air bubbles sucked in through the snifter from the previous cycle, through the check valve and into the accumulator filled with air. This movement of water into the accumulator causes the air to compress until the forward momentum is stopped. At this point the water in the accumulator bounces back because of the spring effect of the air in the accumulator. This rebound in the opposite direction causes the check valve to suddenly close, causing negative pressure in the hydram before the check valve. Because of this negative pressure, air is sucked in through the snifter and the impulse valve is caused to open again at which point water starts exiting through the impulse valve and the cycle starts again.

2. $H = 20$

   $h = 100 + 20 = 120$

   $Q = 10$

   $n = .50$

   $q = Q \times \frac{H}{h} \times n$

   $q = 10 \times \frac{20}{120} \times .50 = .8333 \text{ gpm}$

   $.8333 \text{ gpm} \times 1440 \frac{\text{min}}{\text{day}} = 1200 \text{ gpd}$

3. 5 3/8" on the weir table is 37.25 gpm. This times four equals 149 gpm.

4. Any answer within reason is OK.

5. Any answer within reason is OK.

SESSION 6

SESSION 6: HYDRAM THEORY Total Time: 2-3 hours

OBJECTIVES: By the end of this session trainees shall be able to:

- articulate hydram theory, and
- develop basic guidelines for preliminary sizing and design.

OVERVIEW: This lecture/problem-solving session explores in depth the relationship between basic theory and design/sizing of ram installation.

MATERIALS: flip chart or chalkboard
Handouts 6A, 6 B, 2B

PROCEDURES | NOTES

1. Introduce the session by summarizing what has been learned so far, i.e., basic principles, how a ram works, how to measure water flow and heads, how to calculate amount of water to be pumped. Explain that next step is to take a more in-depth look at all of the factors affecting the amount of water a ram can deliver and what that means in terms of design and sizing. State objectives of the session.

   NOTES: This material can be presented at a number of levels of technic complexity. The trainer, by now will have a sense of the group's level. This manual is written from a basic technical level.

2. Present general information on pressure, including:

   NOTES: Limit the amount of time spent on pressure to 10 min. and link directly to the ram.

   - review of the basic definition:

     $$\text{pressure} = \frac{\text{force}}{\text{area}}$$

     and the standard units:

     psi = pounds/square inch

   NOTES: Write on board:
   .433 psi = 1 ft. water
   1 psi = 28" water or 2.3 ft

   - definition of gauge pressure and atmospheric pressure, including the relationship between the two.

3. Describe, using handout 6A, amount of pressure per foot of water, i.e., .433 psi = 1 ft and application to measuring heads with a pressure gauge. Ask participants to solve the following problems:

   - If the pressure gauge reading is 75 psi, how high is the head?

     NOTES: answer $\cong$ 173.1 ft

   - To simulate a 200 ft head, what should be the psig?

     NOTES: answer $\cong$ 86.6 psi

4. Recall that the concept of the hydram is based on the concept of potential energy; and the relationship of potential energy to kinetic energy. Ask for a definition of kinetic energy and write on the board or flipchart:

   $$E_k = \tfrac{1}{2}mv^2.$$

PROCEDURES	NOTES
5. Show that maximizing velocity optimizes kinetic energy.	If this concept is difficult use an example: m = 2 4 2 v = 6 6 12 ke = 36 72 144 Doubling mass has less effect than doubling velocity.
6. Ask/explain how maximum velocity is affected by or affects: - drive pipe diameter - drive pipe length - frequency of impulse valve - maximum delivery head	
7. Ask how stroke and weight affect frequency of impulse valve, and how frequency affects: - amount of water delivered - amount of water used by the hydram - overall efficiency of ram	
8. Ask participants for the formula of the amount of water delivered. Write it on the board/flip chart Ask/explain effect of $\frac{H}{h}$ ratio on:	$q = \frac{nQH}{h}$
- quantity of water delivered	Generally increases as H:h increases.
- efficiency	Increases as H:h decreases.
9. Discuss how the length of drive pipe is affected by:	
- drive head - drive pipe diameter - topographical limitations - cost	Refer to glossary for L:D and L:H ratios.
10. Ask participants to determine best L for D = 1", and H = 10'	

PROCEDURE - continued

11. Explain the importance of rigidity in the drive pipe and in the hydram before the check valve.

12. Review the role of the air cushion in the accumulator and explain how the amount of air in the accumulator affects hydram efficiency.

13. Discuss the role of the snifter.

14. Distribute Handout 6B; point out that it includes some additional terms. Ask participants to look at the flow rate range table on the second page. Explain that flow rate (Q in gpm) is preliminary indicator of ram size. There are two general ways to estimate size:

    1) table

    2) $Q = 3D^2$ or $D^2 = \frac{Q}{3}$

    Ask participants for appropriate D for Q = 30 gpm.

15. On the board/flip chart, present the size relationships relative to the drive pipe diameter:

    - impulse valve = 2D
    - delivery pipe (d) = ½D
    - check valve = 1D
    - accumulator
      diameter = 3D
      height = 18"

16. Summarize by asking trainees to size all components in the following situations:

NOTES

These are "rules of thumb", not necessarily precise indicators.

1) table: D = 3"
2) formula: D = 3.16"
Since pipe is in basic sizes, D = 3".

PROCEDURES

16. - continued

a. Given: 4 garden beds, each 1.5m x 12m. Need 5cm water twice a week. Ram site is 40m below. Q unlimited, maximum possible H is 6m.

Determine size ram, and installation details.

b. Given: House needs 700 liters per day. It is located 30m above stream. The stream rises 1m every 30m length. Q = 10 liters/min.

Design system, size the ram.

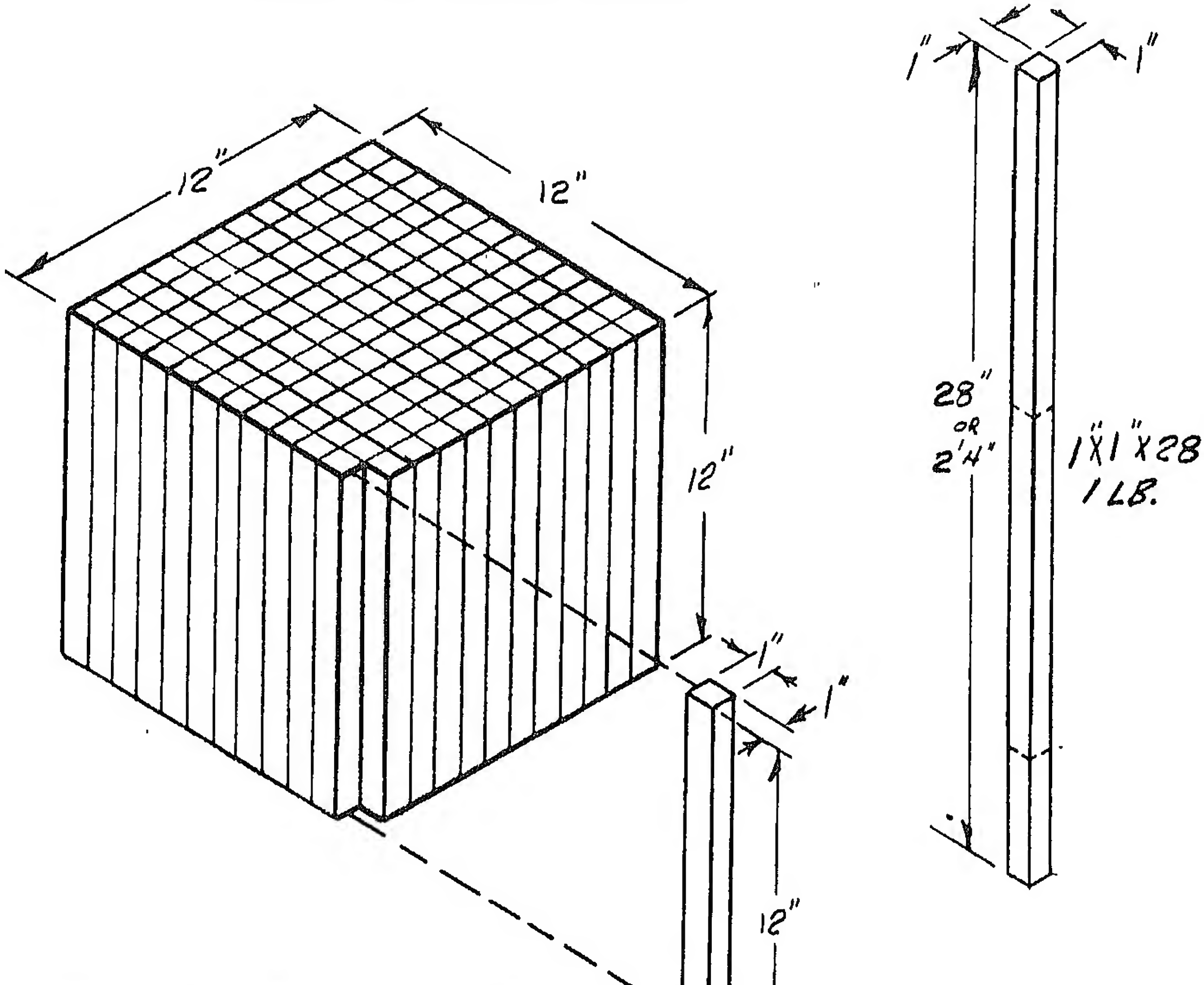
c. Given: Community of 50 people. Each person needs 40 liters/day. Ram site is 5m below stream. Community storage is 95m below stream. Size ram and all parts.

17. Ask for volunteers to present solutions. Ask participants to verify or present their alternatives.

NOTES

Participants may work together it's important to emphasize the process of sizing, not right answers only. Trainers should circulate, ask and answer clarifyi questions and encourage participar to solve problems on their own. allow 20-30 min.

ATTACHMENT 6-A PRESSURE ANALYSIS



1 FT^3 OF WATER = 62.4 LBS.

$1'' \times 1'' \times 1' = \frac{62.4}{144} = .433$ LBS

Attachment 6-B

GLOSSARY OF TERMS FOR SESSION 6

Atmospheric pressure - the pressure at sea level caused by the weight of air; atmospheric pressure = 14.7 psia, and 0 psig

Force - (delivery to drive head ratio) the ratio of lift to fall. The inverse of this ratio times the efficiency of the hydram will determine the percentage of water that the hydram will pump. The higher the h:H ratio, the lower the hydram efficiency (n). The usual range of the h:H ratio is from 2:1 to 20:1, but h:H ratios have been measured up to 60:1.

Hydram capacity - the maximum amount of water that a hydram can use. This is determined by the drive pipe size and length, the drive head, and the impulse valve size and design.

Impulse valve stroke - the distance the impulse valve travels during a cycle.

Impulse valve weight - the total weight or downward force of the impulse valve and its springs or weights.

Kinetic energy - active energy, ½ the mass times the velocity squared

$$E_k = \frac{1}{2} mv^2$$

Pressure - force applied over a surface measured as force per unit of area such as pounds per square inch (psi) (a head of 28" of water develops a pressure of 1 psi) or a pascal (Pa) which is equal to 1 newton per square meter (a head of 1 cm = 98 Pa) 28" of water equals 71.1 cm of water equals 1 psi = 6895 Pa.

psia - (pounds per square inch absolute) the total real pressure as if the atmospheric pressure is not present. Atmospheric pressure at sea level is 14.7 psi, so if a pressure gauge reads 100 psi (psig) the absolute pressure is 114.7 psia.

psig - (pounds per square inch gauge) the pressure that a gauge reads, actually the pressure above atmospheric.

Static head - a column of water without motion. The static drive head of a hydram can be measured with a pressure gauge but only when the ram is stopped and the drive pipe is full of water.

Time of cycle - (t) the time it takes for a hydram to complete one cycle, such as the time lapse between the impulse valve closing twice.

Velocity - speed usually measured in feet per second or meters per second.

Water used - (Q) the amount of water that flows through the drive pipe during a unit of time (as in gallons per minute or liters per second) which is equal to the water pumped (q) plus the water wasted (Q_W).

The flow rate range of hydrams are as follows:

Drive pipe diameter		Flow rate		
mm	in	U.S. gal/min	Imperial gal/min	liters/min
19	3/4	0.8 - 2	0.6 - 1.7	2.8 - 7.6
25	1	1.5 - 4	1.3 - 3.3	5.7 - 15.0
32	1¼	1.5 - 7	1.3 - 5.8	5.7 - 26.0
38	1½	2.5 - 13	2.0 - 10.8	9.4 - 49.0
50	2	6.0 - 20	5.0 - 17.0	23.0 - 76.0
63	2½	10.0 - 45	8.0 - 38.0	38.0 - 170.0
75	3	15.0 - 50	13.0 - 42.0	57.0 - 189.0
100	4	30.0 - 125	25.0 - 104.0	113.0 - 473.0
125	5	40.0 - 150	33.0 - 125.0	151.0 - 567.0

Attachment 6B - continued

Determining Drive Pipe Length, L:

1. Consider drive head, H

L:H ratio - drive pipe length to head ratio, when H is less than 15 ft. (4.5m) L:H should equal 6.

When H is greater than 15 ft (4.5m), but less than 25' (8m) L:H should equal 4.

When H is greater than 28 ft. (8m), but less than 50' (16m) L:H should equal 3.

When H is greater than 50 ft. (16m) L:H ratio should equal 2.

2. Consider drive pipe diameter, D

L:D ratio - drive pipe length to diameter ratio, should be kept between 150 and 1000.

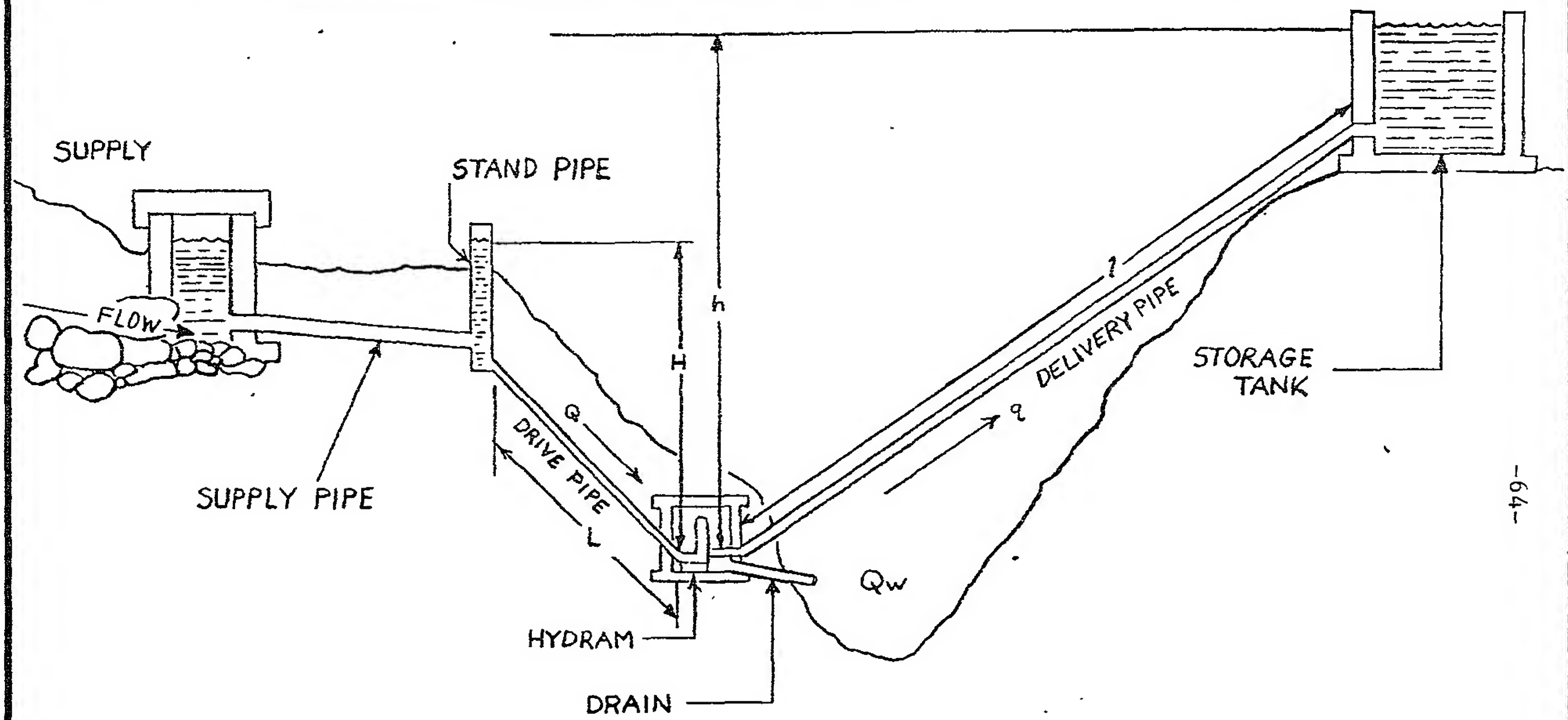
A rule of thumb: maximum number of pipe lengths = 4D
(based on chart below, and 21' pipe length)
Optimal number of pipe lenghts = 2D

D	L = 150D	L = 500D	L = 1000D	No of pipes
½"	6.25	20.8	41.6	2
3/4"	9.3	31.25	62.5	3
1"	12.5	41.6	83.2	4
1¼"	15.6	52.0	104.0	5
1½"	18.6	62.5	125.0	6
2	25.0	83.2	166.4	8

IMPORTANT NUMBERS TO REMEMBER

1440 minutes in a day
.433 psi per foot (measured vertically) of water column
28 inches of a water column produces 1 psi
14.7 psi atmospheric pressure
7.48 gallons per cubic foot

ATTACHMENT 2-B HYDRAM INSTALLATION



DEFINITION OF VARIABLES

D = Diameter of Drive Pipe	d = Diameter of Delivery Pipe
H = Head of Drive Pipe	h = Head of Delivery Pipe
L = Length of Drive Pipe	l = Length of the Delivery Pipe
Q = Quantity of Water Entering Hydram	q = Quantity of Water Delivered
	n = efficiency
Q_w = Quantity of Water Wasted from Impulse Valve	S = Length of the Impulse Valve Stroke
	F = Frequency of the Impulse Valve Stroke
	W = Weight of the Impulse Valve

SESSION 7

SESSION 7: BASIC PLUMBING TOOLS AND MATERIALS Time: 1-1½ hours

OBJECTIVES: By the end of this session trainees will have

- o learned and demonstrated basic plumbing skills necessary for constructing and installing a hydram.

OVERVIEW: The session should familiarize participants with all commonly used plumbing tools and pipe fittings, although project-specific skill requirements may vary with the type of hydram construction foreseen and the availability of tools at the worksites. Participants learn:

- to identify tools and fittings (including host country language names, where possible);
- to use the tools properly and competently; and
- to explain and demonstrate safety precautions necessary in use of plumbing tools, espcially torches and power tools when used.

MATERIALS:

- o Pipe joint compound or TFE tape
- o Cutting oil and rag
- o Miscellaneous pipe fittings and pipe, galvanized and PVC
- o PVC cleaner and glue
- o Handout 7A

TOOLS: Pipe vise, two pipe wrenches, chain wrench, pipe threader, spud or monkey wrench, etc. (the quantities may increase depending upon the number of trainees but basically all the tools needed for all the exercises should be present and discussed), pipecutter or hacksaw.

PROCEDURES

1. State the objective of this session and explain that the skills the trainees are expected to develop are necessary for hydram installations.

2. Show the fittings one at a time to all the trainees explaining their purpose and nomenclature.

3. Demonstrate the use of pipe joint compound or TFE tape.

4. Demonstrate the use of all the tools and any necessary safety precautions.

5. Set up 2 or 3 workstations, one with pipefittings laid out and labeled, another with a threader and cutting and/or joining station. Have one trainer at each station and the participants revolving to each station. Allow the trainees to practice using all the tools until they and the instructor are confident with their ability to properly use them.

NOTES

Be certain to mention that on a 1x1x½" tee, the ½" dimension refers to the arm of the tee.

It is important to stress that their purpose is three-fold; to seal, to facilitate easier installation, and to facilitate easier removal.

If at all possible, actual fittings and tools should be demonstrated and practiced on. Attachment 7A can be used to describe the fittings if lack of time or facilities prevent "hands-on" practice. The handout is more useful as a learning reinforcement and as an aid for the trainees to use in describing and acquiring fittings at a plumbing supply house.

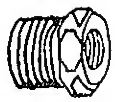
Names of materials and tools may be different from what is used in the U.S. It is important to find out what each are called and call them by the local name.

ATTACHMENT 7A

PIPE FITTINGS

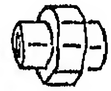
BASIC PLUMBING

PLUG

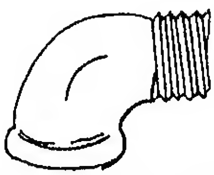


REDUCING BUSHING

CAP

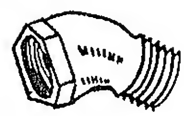


UNION



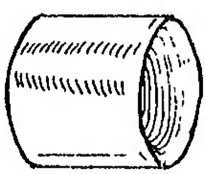
90° STREET ELBOW

90° ELBOW



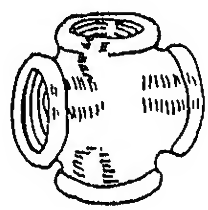
45° STREET ELBOW

45° ELBOW

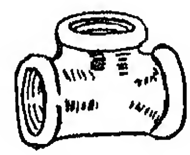


COUPLING

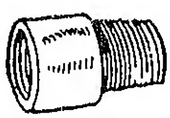
BELL REDUCER



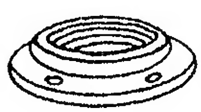
CROSS



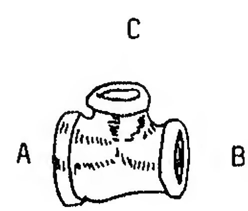
TEE



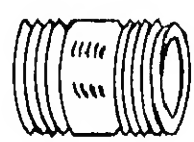
EXTENSION PIECE



FLOOR FLANGE



REDUCING TEE
(AxBxC)



NIPPLE

SESSION 8

SESSION 8 : HYDRAM CONSTRUCTION - PIPE FITTING Time: 4 - 6 hours

OBJECTIVE: To build a hydram out of plumbing parts, with modified and/or fabricated valves.

OVERVIEW: This session provides the opportunity for participants to build two variations of the pipe-fitting hydram. The first, a modified pipe-fitting hydram, is made exclusively from parts usually found in a plumbing supply house, with minor modifications to the check and foot (impulse) valve. The second hydram is made from pipe fittings, with valves constructed by trainees using simple steel fabrication. The finished hydrams are installed on a test stand or other water source and set in operation.

MATERIALS NEEDED FOR MODIFIED PIPE-FITTING HYDRAM

- Handouts 8A, 8B, 8C
- 4 1" nipples
- 1 1" tee
- 1 1"x 1"x ½" tee
- 1 2"x 1" reducing bushing
- 1 3"x 1" reducing bushing
- 1 2" foot valve
- 1 1" check valve with tapped holes
- 1 ¼" plug
- 1 1/8" gas cock
- 1 1" 90° sweep
- 1 1" union
- 1 ½" union
- 2 ½" nipples
- 1 ½" gate valve
- 1 3" female adapter
- 1 3" cap
- 1 3"x 18" metal pipe
- pipe joint compound or TFE tape
- assorted washers

TOOLS NEEDED FOR MODIFIED PIPE-FITTING HYDRAM

two pipe wrenches, two pair pliers

MATERIALS NEEDED FOR FABRICATED PIPE-FITTING HYDRAM

Handouts 8B	30" 3/8-16 althread
pipe joint compound or TFE tape	4 3/8-16 nuts
1 3" cap	1 ¼-20x1" bolt (drilled out
2 3" tees	1 ¼-20 x 3/4" bolt
3 3"x 1" reducing bushings	1 ¼-20 x 4" althread
1 3"x ½" reducing bushing	1 2½" OD washer
1 3"x 18" nipple	6 1½" OD washer
1 ½"x 4" nipple	4 ¼-20 nuts
1 1" 90° sweep	1 3/4" OD washer
6"x 8"x ¼" sheet rubber	5 8-32 x 3/4" screws
6"x 6"x ¼" steel plate	2 8-32 x 3/4" bolts
3"x 1"x 1/8" angle iron	

TOOLS NEEDED FOR FABRICATED PIPE-FITTING HYDRAM

two pipe wrenches	knife
electric or hand drill	flat file, half round file
drill bits (3/8, 13/64, and 1/8)	hack saw
2" hole saw	1" pipe threader
¼-20 and 8-32 taps	tape measure
screwdriver	adjustable wrench
access to metalworking shop	sandpaper (medium & fine)

*NOTE: Consider "charging" trainees for parts they use to determine on site cost.

Post parts, price list and ask trainees to price the rams they're constructing.

PROCEDURES

1. State the objective of this session.

2. Distribute Handouts 8A and 8B

3. Describe the advantages and disadvantages of the modified and fabricated pipe-fitting hydrams.

NOTES

The two pipe-fitting hydrams are quite similar. If it is likely that trainees will be constructing hydrams from plumbing parts in their projects, it may be useful to have the group build both types; if concrete or manufactured hydrams are planned for the projects, trainers may choose to introduce only one. The modified valve ram requires considerably less time, but experience in fabricating valves may be helpful for trainees building a concrete ram.

Some advantages and disadvantages of each hydram are:

	MODIFIED	FABRICATED
ADVANTAGES	one hour constuction time	3 hours construction time
	efficient operation	efficient operation
	fairly inexpensive	inexpensive
	easy to service/replace parts	impulse valve easily removed
		excellent longevity
DISADVANTAGES	valves last approx 1 yr	requires ability to drill and tap sheet metal
	valves may be hard to find	maximum practical size 1"
	maximum practical size 1 1/4"	check valve difficult to remove when rusted
	fittings difficult to remove when rusted (especially larger sizes)	

4. Divide the trainees into groups of two or three to work on designs & responsibilities.
5. Ask the groups to build the hydrams using the following sequence:

Try to make sure that the skill levels of each group are roughly equal.
If you wish, have each group build a different size hydram.
Allow 45 minutes to design

PROCEDURES - continued

(FOR MODIFIED PIPE-FITTING HYDRAM)

5. A. remove the spring from both the foot valve and the check valve;

   B. add washers in the foot valve for both the weight and stroke adjustment;

   C. assemble all the fittings as shown in Handout A using either pipe joint compound of TFE tape.

6. Have each group install their hydram on the test stand or another source of water and start the hydram working.

7. Discuss the applicability of the modified pipe-fitting hydram.

NOTES

See Handout 8A, detail A

Discussion should include skills of community, availability of materials, financial resources available.

PROCEDURES - continued

(FOR FABRICATED PIPE-FITTING HYDRAM)

6. Impulse Valve

A. Sand, grind or file the aim of a 3" tee (#3) until it has a smooth surface.

B. Bend two pieces of 3/8 x 15" althread (#27) around the body of the tee so that the 4 ends extend 1" above the arm.

C. Drill a 2" hole in the center of a 6"x 6" piece of steel (#14), then drill 3/8" holes in the corners of the steel where the althread goes through (approx. 4½" apart). Be certain to sand smooth and round off all edges. Drill and tap two 8-32 holes in plate as shown in Handout 9B, detail A #14, and attach the stroke adjustment bracket (#22).

D. Cut out a piece of rubber (#15) with the same outside dimensions and hole pattern as the steel plate but with a horseshoe-shaped hole in the middle as shown in Handout 9B (#15).

E. Assemble the impulse valve as shown in Handout 9B, Detail A.

7. Snifter

Extend the thread on one end of a 1" 90° sweep (#7) to extend through a 1 x 3" reducing bushing (#4). Drill and tap a ¼-20 hole near the extended end of the sweep and assemble the snifter as shown in Handout 9B, Detail C, so that the air hole can be covered and uncovered by the lock nut.

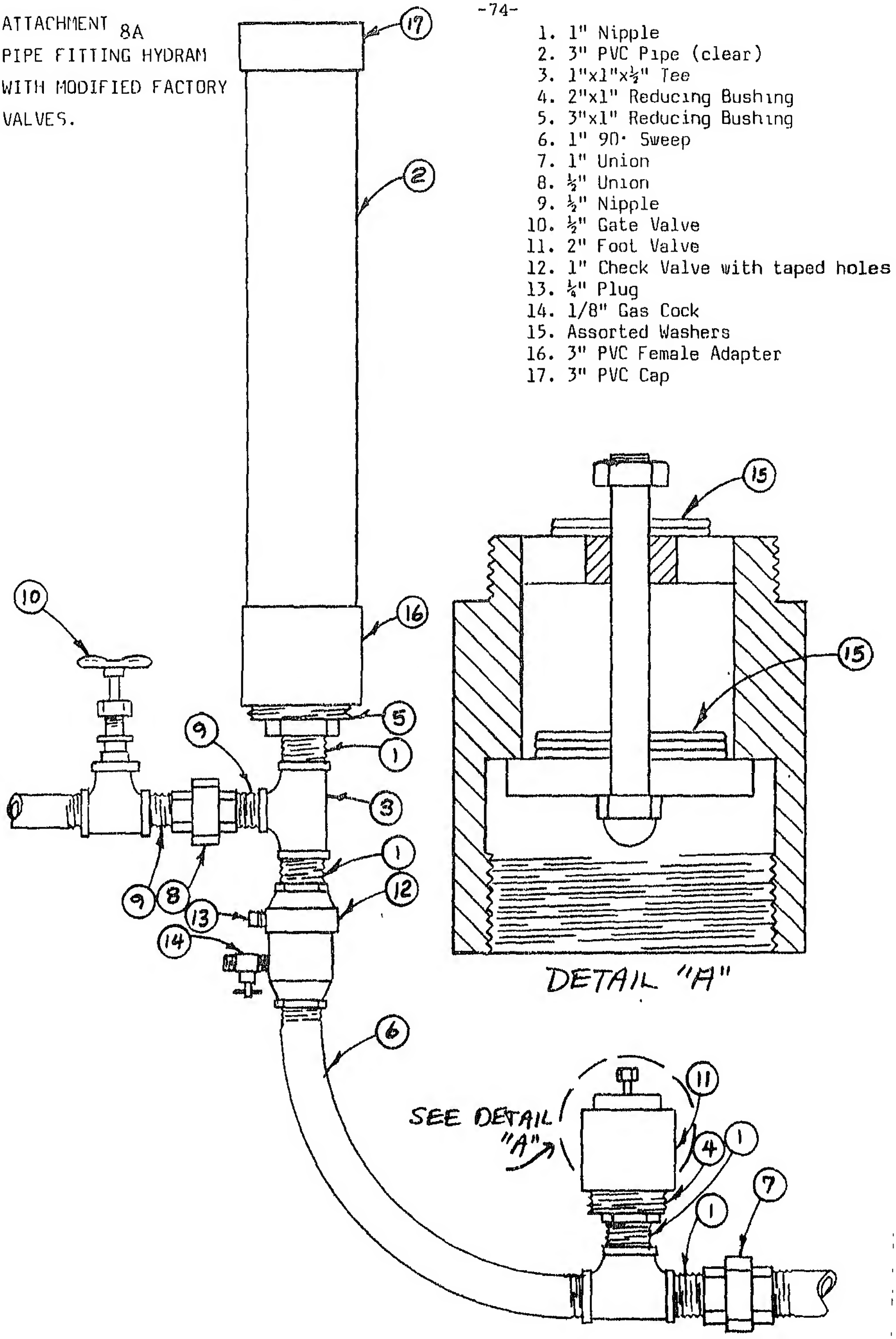
NOTES

The instructions describe the building of a 1" hydram If you wish, have each group build a hydram of a different size. Allow 3-4 hours for construction, organize parts ahead of time. Time constraints may require that trainer have impulse valve plates pre-cut, and cut sheet rubber into correct size squares.

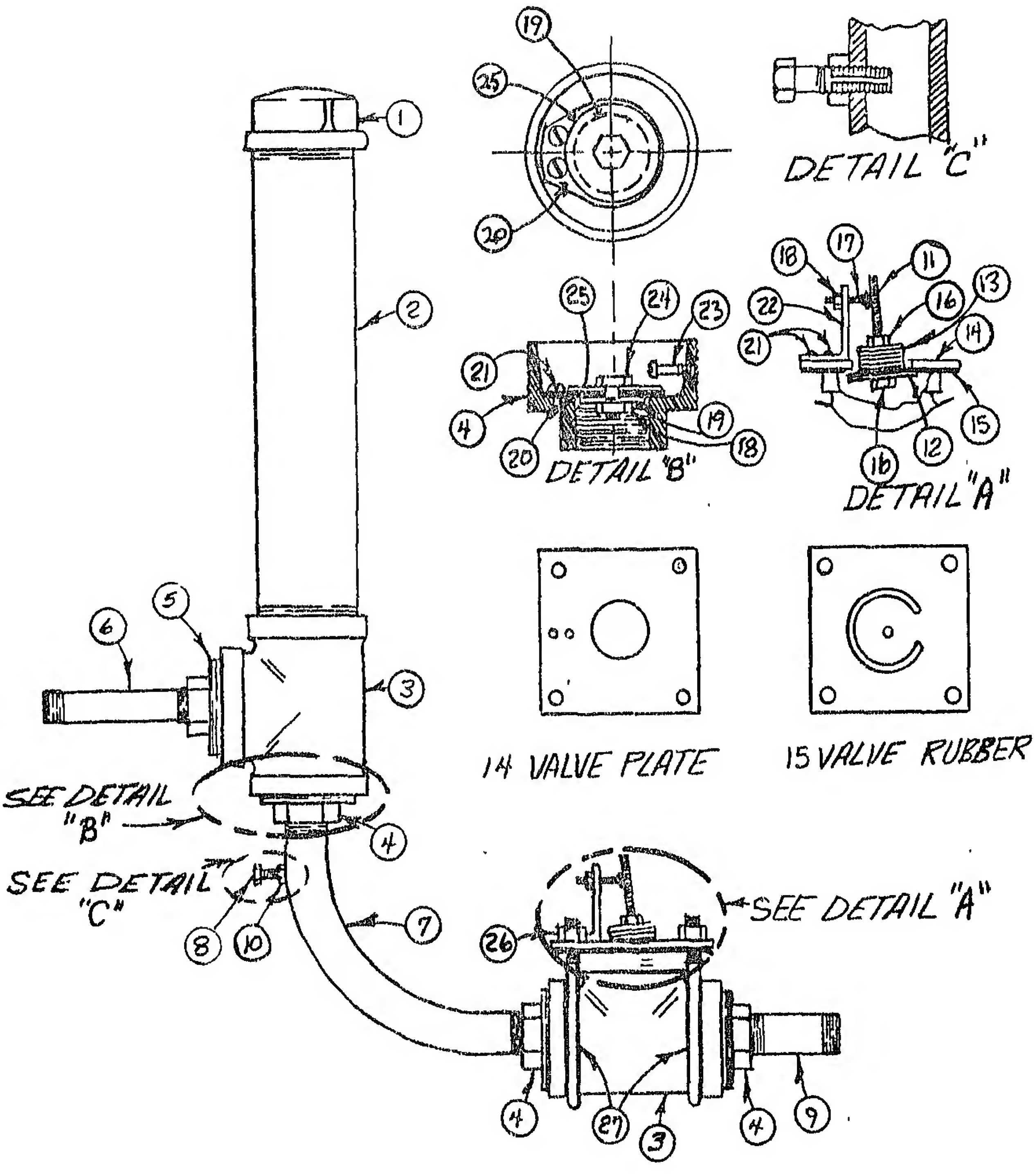
PROCEDURES	NOTES
8. Check Valve	
A. Drill and tap two holes in the bottom and one in the side of a 1 x 3" reducing bushing for 8-32 screws as shown in the Handout, detail B.	The hole in the side should be located so that the 8-32 screwhead will be 1/16" above the check valve rubber.
B. Cut out a piece of rubber (#20) for the check valve, bolt washers to the rubber and screw the valve to the 1 x 3" reducing bushing.	
C. Drill and tap a hole in the bottom of the bushing opposite the 2 previously drilled holes. When a 8-32 screw is inserted the head will overlap the check valve, creating an adjustable stroke. (See Detail B)	
9. Body of the Ram	
Attach all the fittings as shown in Handout 8B, using either pipe joint compound or TFE tape.	
10. Have each group install their hydram on the test stand or another source of water and start the hydram working.	
11. Discuss the applicability of the fabricated pipe-fitting hydram.	Discussion should include skills available in community, availability of materials, financial resources.

ATTACHMENT 8A
PIPE FITTING HYDRAM
WITH MODIFIED FACTORY
VALVES.

1. 1" Nipple
2. 3" PVC Pipe (clear)
3. 1"x1"x½" Tee
4. 2"x1" Reducing Bushing
5. 3"x1" Reducing Bushing
6. 1" 90· Sweep
7. 1" Union
8. ½" Union
9. ½" Nipple
10. ½" Gate Valve
11. 2" Foot Valve
12. 1" Check Valve with taped holes
13. ¼" Plug
14. 1/8" Gas Cock
15. Assorted Washers
16. 3" PVC Female Adapter
17. 3" PVC Cap



ATTACHMENT 8B PIPE FITTING HYDRAM WITH FIELD-MADE VALVES



1. 3" cap
2. 3"x18" nipple
3. 3" tee
4. 3"x1" reducing bushing
5. 3"x½" reducing bushing
6. ½"x4" nipple
7. 1" 90° sweep
8. 1" ¼-20 bolt (drilled out)
9. 1" nipple
10. ¼-20 nut
11. ¼-20x4" piece of althread or bolt with 1/8" hole in it
12. 2½" diameter washer
13. 1½" or smaller washers
14. impulse valve plate
15. impulse valve rubber
16. ¼-20 nuts
17. ¼-20x½" bolt
18. ¼-20 nuts
19. 3/4" washer
20. check valve rubber
21. 8-32x3/4" screws
22. stroke adjustment bracket
23. 8-32x3/4"
24. ¼-20x3/4" bolt
25. 1½" washer
26. 3/8-16 nuts (4)
27. 3/8-16 althread

HANDOUT 8C

MATERIALS NEEDED FOR FABRICATED PIPE-FITTING HYDRAM

Handouts 9-B,

pipe joint compound or TFE tape

1 3" cap

2 3" tees

3 3"x 1" reducing bushings

1 3"x ½" reducing bushing

1 3"x 18" nipple

1 ½"x 4" nipple

1 1" 90° sweep

6"x 8"x ¼" sheet rubber

6"x 6"x ¼" steel plate

3"x 1"x 1/8" angle iron

30" 3/8-16 althread

4 3/8-16 nuts

1 ¼-20x1" bolt (drilled out)

1 ¼-20 x 3/4" bolt

1 ¼-20 x 4" althread

1 2½" OD washer

6 1½" OD washer

4 ¼-20 nuts

1 3/4" OD washer

5 8-32 x 3/4" screws

2 8-32 x 3/4" bolts

TOOLS NEEDED FOR FABRICATED PIPE-FITTING HYDRAM

two pipe wrenches

electric or hand drill

drill bits (3/8, 13/64, and 1/8)

2" hole saw

¼-20 and 8-32 taps

screwdriver

access to metalworking shop

knife

flat file, half round file

hack saw

1" pipe threader

tape measure

adjustable wrench

sandpaper (medium & fine)

PROCEDURES - continued

NOTES

(FOR FABRICATED PIPE-FITTING HYDRAM)

6. Impulse Valve

A. Sand, grind or file the aim of a 3" tee (#3) until it has a smooth surface.

B. Bend two pieces of 3/8 x 15" althread (#27) around the body of the tee so that the 4 ends extend 1" above the arm.

C. Drill a 2" hole in the center of a 6"x 6" piece of steel (#14), then drill 3/8" holes in the corners of the steel where the althread goes through (approx. 4½" apart). Be certain to sand smooth and round off all edges. Drill and tap two 8-32 holes in plate as shown in Handout 9B, detail A #14, and attach the stroke adjustment bracket (#22).

D. Cut out a piece of rubber (#15) with the same outside dimensions and hole pattern as the steel plate but with a horseshoe-shaped hole in the middle as shown in Handout 9B (#15).

E. Assemble the impulse valve as shown in Handout 9B, Detail A.

7. Snifter

Extend the thread on one end of a 1" 90° sweep (#7) to extend through a 1 x 3" reducing bushing (#4). Drill and tap a ¼-20 hole near the extended end of the sweep and assemble the snifter as shown in Handout 9B, Detail C, so that the air hole can be covered and uncovered by the lock nut.

PROCEDURES - continued

8. Check Valve

A. Drill and tap two holes in the bottom and one in the side of a 1 x 3" reducing bushing for 8-32 screws as shown in the Handout, Detail B.

B. Cut out a piece of rubber (#20) for the check valve, bolt washers to the rubber and screw the valve to the 1 x 3" reducing bushing.

C. Drill and tap a hole in the bottom of the bushing opposite the 2 previously drilled holes. When a 8-32 screw is inserted the head will overlap the check valve, creating an adjustable stroke. (See Detail B)

9. Body of the Ram

Attach all the fittings as shown in Handout 9B, using either pipe joint compund or TFE tape.

10. Have each group install their hydram on the test stand or another source of water and start the hydram working.

11. Discuss the applicability of the fabricated pipe-fitting hydram.

NOTES

The hole in the side should be located so that the 8-32 screwhead will be 1/16" above the check valve rubber.

SESSION 4

SESSION 9: HYDRAM DESIGN THEORY AND PARAMETERS Time: 2 hours

OJBECTIVES:
- to examine the basic design guidelines for hydrams;
- to apply the guidelines to pipefitting, welded and/or concrete rams

OVERVIEW: This session is included here, as an option, primarily for use in locations where welded hydrams can be used. The purpose is to provide the basic parameters for designing fabricated valves, seat widths, and backing plates for valves. At this time, the sizes to be used will be taken from the concrete design theory, which will be somewhat oversized for metal. In time, specific charts may be developed for welded steel.

PREPARATION NOTES: Trainers will have made a decision about the type of constructions to be included in this training workshop. If a welded ram is to be constructed, i.e., if it has been decided that the expertise is available, the welded ram parts should be completed by this time. It is not the purpose of this workshop to teach welding skills.

At least one hydram construction must be completed at this point so that measurements of seats can be taken.

MATERIALS: Handouts 10B - 10F
Previously constructed rams
Chalkboard/chalk; flipcharts/markers
Welded ram design, Attachment 9A

<u>The factors that influence the siting</u> of these components are:

1) flood considerations,

2) available head,

3) distances/pipe length between components,

4) cost factors,

5) convenience of location,

6) social factors.

1) <u>Flood Considerations</u>: The seasonal variations of the stream must be taken into consideration - this is particularly true of flood conditions. Each component of the system must be placed outside the potential flood area.

2) <u>The available head</u> and that necessary for the system is the key factor in siting the system. There are three heads involved here: the drive head, the delivery head, and the supply head. The most important of these is the drive head, H. This H basically determines what the capabilities of the system are. The delivery head, h, is next in importance; it is however limited by the constraints placed on the system by the size of the drive head. The least important of the heads is the supply line head, h. Basically this head just needs to have a negative slope - that is, sufficient drop to let the water run down hill.

3) <u>Distances or pipe lengths</u> are the next major consideration in selecting a site for the system. Pipes are usually the most costly items of the system. There are three distances that must be taken into account: the length of the drive line, the length of the delivery line, and the length of the supply line. The most crucial of these is the drive line because this piping is usually the most expensive per foot and because the size of the pipe is influenced by the distance it must transverse. As a rule - the shorter the drive pipe line the better (considering that it delivers the necessary head). The length of the delivery line is next in order of importance. It is constrained by the capacity of the system and by costs. However plastic pipe can be used here. The supply line is constained by cost factors only. It can be run as far as the terrain and the budget allows.

4) <u>The cost of a system</u> may be the final determinant as to whether or not it is implemented. Pipes and plumbing components are the main expense, with cement and possibly labor second. The hydram itself is a lowly third. If care is taken in the siting and the design of the system, the costs can be kept to their minimum.

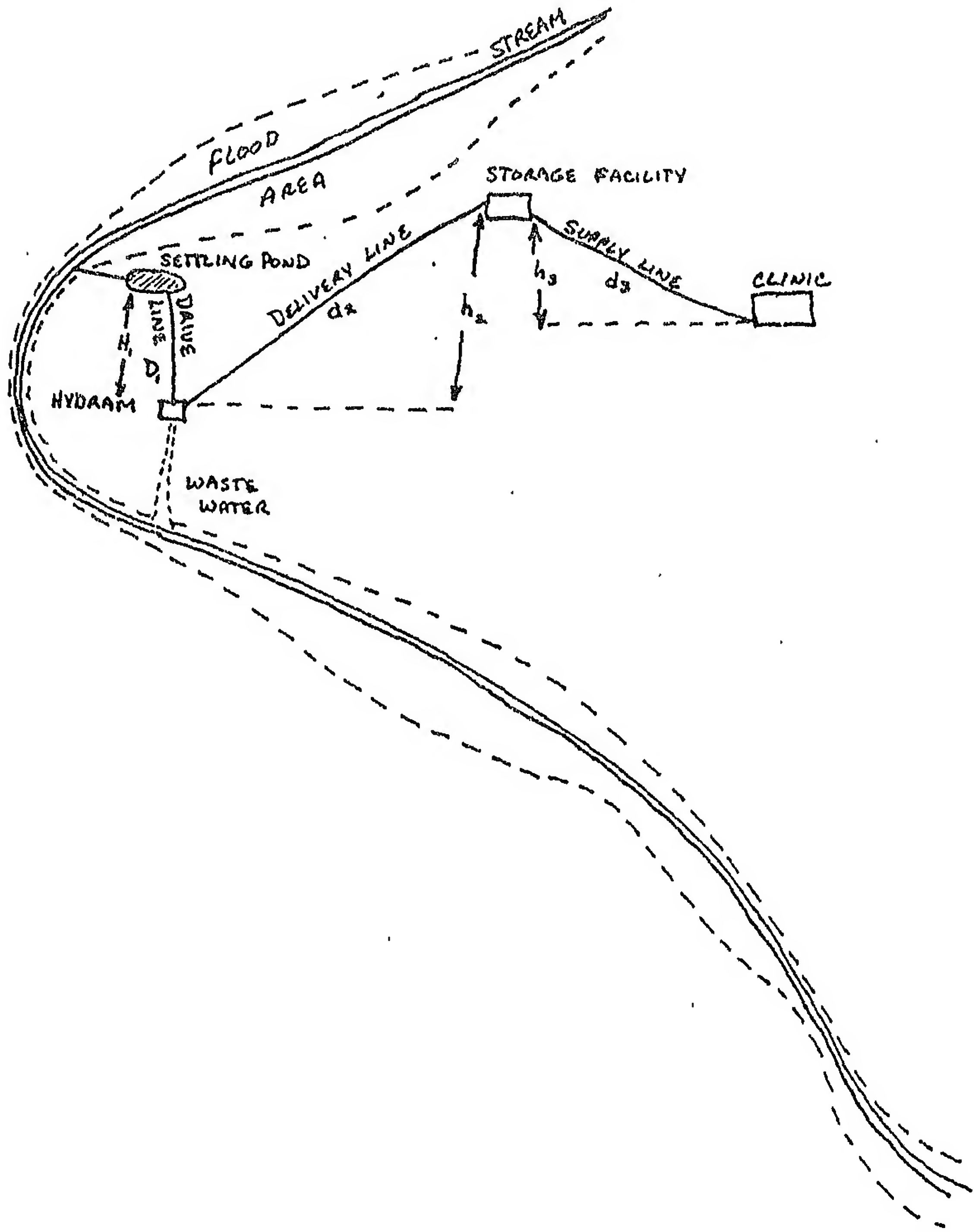
5) Convenience of location of the hydram and the storage facility is another siting factor. Basically the components of the system should be sited in a location that allows for ease of construction, repairs and maintenance.

6) Lastly, the "best" site for the system may not be the one that the villagers want - it may be on the wrong persons land, or whatever. Remember that they are responsible for maintaining the system, and their concerns must be honored.

Presented below is a handy table to keep the components of the system and the siting factors in mind as the survey work is being done.

	COMPONENTS		
SITING FACTORS	TAKE OFF	HYDRAM	STORAGE FACILITY
FLOOD CONSIDERATIONS			
HEAD			
DISTANCES			
COSTS			
CONVENIENCE			
SOCIAL FACTORS			

DIAGRAM OF HYDRAM SYSTEM FOR SITE SELECTION



SESSION 19: PROJECT PLANNING Time: 2 hours

OBJECTIVES: By the end of this session, participants will have completed a plan for a hydram project at their site. The plan will include problem definition, an articulation of why a hydram is the most appropriate solution, goals, activities, resources, responsibilities, monitoring and evaluation.

OVERVIEW: The key issues in hydram project implementation, and therefore planning, have been raised throughout the workshop. During this session, participants pull it all together, to begin applying what they've learned to their sites. It may even be the case that what they've learned is that hydrams will not work at their sites.

TRAINER"S NOTE: Remind participants to bring along Site Information Worksheet, Cost Calculations, Repair and Maintenance Worksheets, and Site Selection worksheets.

MATERIALS: Flipchart/markers

PROCEDURES

1. Introduce session by stating goals and rationale.

2. Ask participants to spend an hour, individually, developing a plan that includes the following:

   A. Statement of water problem at the site:
      - who needs water, why, how much
      - who perceives the problem
      - what is current situation

   B. Evaluate current situation:
      - where is there water?
      - how much? what quality?
      - accessibility? ownership?
      - current and future needs?
      - community structure, social, political, skills

   C. What are the possible solutions?
      - hydram
      - others..diesel pumpt, gravity pump etc.

   D. Evaluation of solutions for:
      - cost
      - longevity
      - feasibility
      - material needs
      - availability of skills
      - local technical support for repair and maintenance
      - time to install
      - social responsibility
      - reliability
      - results
      - community involvement

   E. For the selected strategy: Develop a schedule of tasks, activities, responsibilities, materials, resource requirements and time frames.

   F. Develop a plan for monitoring progress.

NOTES

(2.) Remind group that much of this is in Site Information Worksheet used in Session 2.

(C.) It's important that participants are clear about hydrams being one solution, and that they evaluate it against all criteria.

(D.) Link this to criteria that have been developed in other sessions in the workshop.

(E.) The tasks and activities should include any further data to be collected; other groups to be included in planning and implementation.

PROCEDURES

3. Ask participants to share their plan with at least one other person, for critique, additions.

   Alternatively ask someone to volunteer to present plan to the whole group.

4. Ask participants if they feel comfortable about the next steps they need to take to implement their learning. If not, it's likely that plan needs revising. Ask if specific parts of the plan require rethinking.

NOTES

If participants are from the same agency it might be appropriate to share plans with each other.

SESSION 20

SESSION 20: WRAP UP AND EVALUATION

Time: 2-4 hours

OBJECTIVES:

- evaluate workshop activities
- provide closure to workshop

OVERVIEW: This session will vary with the actual situation. At a minimum, evaluation forms should be completed, and workshop sponsors should have the opportunity to "close the workshop", with a restatement of their intent re: the development and use of this technology and the skills of the participants.

TRAINER PREPARATION: The disposition of constructed rams is an issue that has probably come up by now. This is a good time to give them away, or announce the decisions. Suggestion: ask interested parties to submit proposals for the rams.

Determine whether or not certificates will be given, and make sure they're printed and ready.

Develop an evaluation form. A sample is attached.

MATERIALS: Depending on above decisions.

Evaluation form, pens, pencils,

Participant roster if one has not yet been distributed.

APPENDIX

PROCEDURES	NOTES
1. State the purpose of the activity. Ask participants if they have any loose ends that need to be tied up. If so, list these on a flipchart developing an agenda of sorts.	
2. Distribute evaluation forms. Allow about 20-30 minutes to complete.	
3. Ask workshop sponsor to close, perhaps with certificates, if appropriate.	

GLOSSARY OF TERMS

Accumulator - (air dome) the air chamber on the hydram which cushions the water hammer, eliminating delivery pulsations and helps provide rebound.

Atmospheric pressure - the pressure at sea level caused by the weight of air; atmospheric pressure = 14.7 and 0 psig.

Battery of Hydrams - (or parallel hydrams) a hydram installation where two or more hydrams are connected to the same source with different drive pipes, but usually with the same delivery pipe. This type of installation is used where the size of the hydram is limited.

Check Valve - (non-return valve, secondary valve, internal valve) the internal valve in the hydram that prevents the delivery head pressure from forcing water back through the hydram body.

Delivery head - the vertical distance between the hydram and the highest level of water in the storage tank that the hydram is pumping to.

Delivery pipe - the pipe which connects the output of the hydram to the storage tank.

Drive head - the vertical distance between the hydram and the highest level of water in the supply system.

Drive pipe - a rigid pipe usually made of galvanized steel that connects the hydram to the source reservoir or stand pipe.

Efficiency - (n) the ratio of the energy input to the energy output; a measure of how well a hydram functions;

$$n = \frac{qh}{QH}$$

Force - to move something against resistance, pressure times the area measured in pounds, newtons or dynes.

Frequency - (f) the number of times a hydram cycles in one minute.

h:H ratio - (delivery to drive head ratio) the ratio of lift to fall. The inverse of this ratio times the efficiency of the hydram will determine the percentage of water the hydram will pump. The higher the h:H ratio, the lower the hydram efficiency (n). The usual range of the h:H ratio is from 2:1 to 20:1 but h:H ratios have been measured up to 60:1.

Holding tank - (storage tank) the means of storing water once it has been pumped to the desired head.

Hydram - (hydraulic ram, hydraulic ram pump, automatic hydraulic ram pump, ram) an ingenious device that uses the force of water falling through a drive pipe to pump water to a height greater than its source, making use of hydraulic principles and réquiring no fuel.

Hydram capacity - the maximum amount of water a hydram can use. This is determined by the drive pipe size and length, the drive head, and the impulse valve size and design.

Impulse Valve - (clack valve, out-side valve, impetus valve, waste valve) the valve on the hydram that creates and controls the water hammer.

Impulse valve stroke - the distance the impulse valve travels during a cycle.

Impulse valve weight - the total weight or downward force of the impulse valve and its springs or weights.

Kenetic energy - active energy, ½ the mass times the velocity squared

$$E_K = \frac{1}{2}mv^2$$

L:D ratio drive pipe length to diameter ratio, should be kept between 150-1000.

L:H ratio - drive pipe length to head ratio, when it is less than 15 ft. L:H should equal 6.

When H is greater than 15 ft, but less than 25 should = 4
When H is greater than 20 " " " " 50 " = 3
When H is greater than 50 L:H ratio should equal 2.
(see Glossary, Session 6 for metric equivalvents)

Potential energy - energy derived from position or height; is equal to the height that a mass can fall times its weight.

Pressure - force applied over a surface measured as force per unit of area such as pounds per square inch (psi) (a head of 28" of water develops a pressure of 1 psi) or a pascal (Pa) which is equal to 1 newton per square meter (a head of 1 cm = 98 Pa) 18" of water equals 71.1 cm of water equals 1 psi = 6895 Pa.

Ram box - the small structure usually made out of concrete and/or wood which houses a hydram protecting it from freezing, weathering and possibly from vandalizing.

Rebound - the flow of water in the ram reversing direction due to the air pressure in the accumulator, closing the check valve.

Series hydram - a hydram installation where two or more hydrams are used in series to pump water higher than one hydram could.

Settling basin - a small tank usually made of steel or concrete that is used in place of a stand pipe in an installation where additional settling is necessary.

Snifter valve - (air valve, spit valve) the small valve just below the check valve that allows air to enter the hydram.

Spring box - a concrete box built around a spring to facilitate water collection and to protect the water source from surface contaminates.

Spring box overflow pipe - a pipe placed in the wall of a spring box near the top for unused water to exit through.

Stand pipe - an open-ended, vertical pipe sometimes used at the beginning of the drive pipe.

Static head - a column of water without motion. The static drive head of a hydram can be measured with a pressure gauge but only when ram is stopped and the drive pipe is full of water.

Supply pipe - everything in a hydram system before the drive pipe, usually including some, but not necessarily all, of the following; spring box, supply pipe, stand pipe, settling basin.

Supply system - everything in a hydram system before the drive pipe, usually including some but not necessarily all of the following; spring box, supply pipe, stand pipe, settling basin.

Time of cycle - (t) the time it takes for a hydram to complete one cycle, such as the time lapse between the impulse valve closing twice.

Velocity - speed usually measured in feet per second or meters per second.

Waste water - (Q_w) the water coming out of the impulse valve and the snifter.

Waste water drain - the drain in the bottom of a ram box which allows the waste water from the hydram to drain out.

Waste water series hydrams - a hydram installation where one hydram uses the waste water from another as a source to pump a higher percentage of the water.

Water delivered - (q) the rate at which water is delivered to the storage tank;

$$q = \frac{Q \times H \times n}{h}$$

Water flow to the hydram - (Q) all the water used by a hydram which is equal to the waste water (Q_w) plus the water delivered (q).

Water hammer - the effect created when water flowing through a pipe is suddenly stopped. In a hydram this causes the closing of the impulse valve and opening of check valve.

Water used - (Q) the amount of water that flows through the drive pipe during a unit of time (as in gallons per minute or liters per second) which is equal to the water pumped (q) plus the water wasted (Q_w)

The flow rate range of hydrams are as follows:

Drive pipe diameter		Flow rate		
mm	in	U.S. gal/min	Imperial gal/min	liters/min
19	3/4	0.8 - 2	0.6 - 1.7	2.8 - 7.6
25	1	1.5 - 4	1.3 - 3.3	5.7 - 15.0
32	1¼	1.5 - 7	1.3 - 5.8	5.7 - 26.0
38	1½	2.5 - 13	2.0 - 10.8	9.4 - 49.0
50	2	6.0 - 20	5.0 - 17.0	23.0 - 76.0
63	2½	10.0 - 45	8.0 - 38.0	38.0 - 170.0
75	3	15.0 - 50	13.0 - 42.0	57.0 - 189.0
100	4	30.0 - 125	25.0 - 104.0	113.0 - 473.0
125	5	40.0 - 150	33.0 - 125.0	151.0 - 567.0

IMPORTANT NUMBERS TO REMEMBER

1440 minutes in a day
.433 psi per foot (measured vertically) of water column
28 inches of a water column produces 1 psi
14.7 psi atmospheric pressure
7.48 gallons per cubic foot

English-Metric Units Conversion Table

Physical Quantity	*This In "English" Units*	*Equals, in Metric** *Spelled out*	*Symbolic*	*Reciprocal†*
DISTANCE	1 inch	2.54 centimeter	2.54 cm	0.3937
	1 foot	0.3048 meter	0.3048 m	3.281
	1 yard	0.9144 meter	0.9144 m	1.094
	1 mile	1.609 kilometer	1.609 km	0.6215
AREA	1 square inch	6.452 square centimeter	6.452 cm^2	0.155
	1 square foot	0.0929 square meter or	0.0929 m^2	10.76
		929 square centimeters	929 cm^2	0.001076
	1 square yard	0.836 square meter	0.836 m^2	1.196
	1 acre	4,047 square meters or	4,047 m^2	0.000247
		0.4047 hectare	0.4047 h	2.47
	1 square mile	2.590 square kilometers or 259.0 hectares	259.0 h	0.00386
VOLUME	1 cubic inch	16.39 cubic centimeters	16.39 cm^3	0.0610
	1 pint (liquid)	473.2 cubic centimeters	473.2 cm^3	0.002113
	1 quart	946.4 cubic centimeters	946.4 cm^3	0.001057
		or 0.9464 liter	0.946 l	1.057
	1 gallon	3.785 liters	3.785 l	0.2642
	1 cubic foot	0.0283 cubic meter	0.283 m^3	35.3
	1 cubic yard	0.765 cubic meter	0.765 m^3	1.308
	1 acre-foot	0.1233 hectare-meter	0.1233 h m	8.11
VELOCITY	1 foot per hour, minute or second	0.3048 meter/hour, minute, or second		3.281
	1 mile per hour	0.4470 meter per second	0.4470 m/s	2.237
	1 knot	0.5145 meter per second	0.5145 m/s	1.944

*Multiply quantity known in British units by this number to get metric equivalent.
†Multiply quantity known in metric units by this number to get British equivalent.

ENGLISH-METRIC UNITS CONVERSION TABLE

Physical Quantity	This In "English" Units	Equals, in Metric* Spelled out	Symbolic	Reciprocal†
ENERGY (OR WORK)	1 watt-second	1.000 joule = 1.000 newton-meter	1.000 J	1.000
	1 foot-pound	1.356 joule	1.356 J	0 7375
	1 Btu	1.055 kilojoule	1.055 kJ	0.948
	1 watt-hour	3.60 kilojoules	3.60 kJ	0.2778
	1 horsepower-hour	2.684 megajoules	2 684 MJ	0.3726
	1 kilowatt-hour	3.60 megajoules	3.60 MJ	0.2778
POWER	1 horsepower	745.7 watts or 0.7457 kilowatt	745.7 W	0.00134
			0.7457 kW	1.341
	1 joule per second	1.000 watt	1.000 W	1.000
	1 Btu per hour	0.293 joule per second	0.293 J/s	3.41
TEMPERATURE	1 degree Fahrenheit	5/9 degree Celsius (Centigrade) for each Fahrenheit degree above or below 32°F	$5/9 \times (T_F - 32)°C$	1.8 degree Fahrenheit for each Celsius degree plus 3
SPECIAL COMPOUND UNITS	1 Btu per cubic foot	37.30 joules per liter	37.30 J/l	0.0268
	1 Btu per pound of mass	2.328 joules per gram	2.328 J/g	0.4296
	1 Btu per square foot per hour	3.158 joules per square meter	3.158 J/m²	0.3167
	1000 gallons per acre	0.0935 centimeters depth		10.70
	1 pound of mass per cubic foot	16.02 grams per liter	16.02 g/l	0.0624
MASS	1 ounce	28.35 grams	28.35 g	0.03527
	1 pound	453.6 grams	453.6 g	0.002205
		or 0.4536 kilogram	0.4536 kg	2.205
	1 ton (short, 2000 pounds)	0.907 megagram	0.907 Mg	1.102
		or 0.907 metric ton	0 907 t	1.102
		or 0.907 tonne	0.907 t	1.102
TORQUE	1 inch pound	0.1130 meter-newton	0.1130 m·N	8.851
PRESSURE	1 pound per square foot	47.88 newtons per square meter	47.88 N/m²	0.02089
	1 pound per square inch	6.895 kilonewtons per square meter	6.895 kN/m²	0.11240
	1 millimeter of mercury	133.3 newtons per square meter	133.3 N/m²	0.0075
	1 foot of water	2.989 kilonewtons per square meter	2.989 kN/m²	0.3346
	1 atmosphere	0.1013 meganewton per square meter	0.1013 MN/m²	9.87

Physical Quantity	*This In "English" Units*	*Equals, in Metric** *Spelled out*	*Symbolic*	*Reciprocal†*
Flow	1 gallon per day	0.04381 milliliters per second	0.04381 ml/s	22.824
	1 gallon per minute	63.08 millileter per second	63.08 ml/s	0.01585
	1 cubic foot per minute	0.4719 liter per second	0.4719 l/s	2.119
	1 cubic foot per second	28.32 liters per second	28.32 l/s	0.0353
Force	1 ounce	0.2780 newton	0.2780 N	3.597
	1 pound	4.448 newtons	4.448 N	0.2248
	1 ton (2000 pounds)	8.897 kilonewtons	8.897 kN	0.11240

REFERENCES

Hydram Manufacturers

Rife Hydraulic Engine Manufacturing Company, 123 Main Street
Andover, New Jersey 07621 USA

John Blake, Ltd., PO Box 43, Royal Works
Acdrington, Lancashire BB5 5LP England

The Skookum Company, Inc., 14041 NE Sandy Blvd.
PO Box 20216, Portland, Oregon 97220 USA

Balaju Yantra Shala (P.) LTD.
Balaju, Kathmandu, Nepal

Southern Cross, Australia

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PHASE I: INTRODUCTION TO TRAINING

Health and Nutrition

The Role of the Volunteer in Development

SHARING PERCEPTIONS OF APPROPRIATE TECHNOLOGY: AN ICE BREAKER

Total time: 2 hours

Objectives:

* To get to know one another and encourage communication
* To find out what "appropriate technology" means to others in the group
* To set the climate for active participation in training

Materials:

* Four large symbols of the wind, sun, water and earth -- drawn on a single sheet of newsprint paper and posted
* List of underlined questions from Steps 4, 6 and 7 on a single sheet of newsprint
* Notebooks, pens

Trainer Notes

> This session will require careful preparation. See the Trainer Notes under Step 4 for instructions.

Procedures:

Step 1. (5 minutes)
Give a brief overview of the objectives that have been written and posted.

Step 2. (35 minutes)
Explain that an exercise in learning and remembering names will follow. State the guidelines for the "name game" and start the exercise.

Trainer Notes

> Any one of various games for remembering names can be employed at this point. One game that has been successfully used is as follows:
>
> * Trainer begins by giving his/her name preceded or followed by a word which
>   1. describes how the trainer is feeling at that moment and
>   2. begins with the same first letter of his/her name (such as "Mike Motivated" or "Nancy Nervous").
>
> Continued

	DAY 1	DAY 2	DAY 3
A.M.	SESSION 1: Sharing Perceptions of Appropriate Technology: an Ice Breaker (Skill Area I) Tour of Training Site	SESSION 2: Defining Expectations of the Community Technology Training Program (I) SESSION 3: Group Resource Assessment (I)	SESSION 5: Development of Skill Criteria (II) SESSION 6: Cross-Cultural Awareness and Communication (I)
P.M.	Peace Corps Administrative Orientation	SESSION 4: Appropriate Education and Learning Processes Parts 1 and 2 (II)	SESSION 7: The Hollow Square (II) SESSION 8: Health in a Cross-cultural Context (I)

	DAY 4	DAY 5	DAY 6
A.M.	SESSION 9: Community Resource Investigation, Parts 1, 2 and 3 (I)	SESSION 11: Communication and Listening Skills (II) SESSION 12: Construction of Earthen Block Molds: A Focus on Group Dynamics (II)	SESSION 14: Global Energy Issues (I) SESSION 15: Introduction to the Evaluation Process (V)
P.M.	SESSION 10: An Exercise in Problem-Solving: Formulating a Plan for Well-Being (I)	SESSION 13: Construction of Earthen Blocks (IV)	SESSION 16: Evaluation and Integration of Training Themes (V)

Trainer Notes/Continued

* Moving clockwise around the room, each participant then takes a turn at repeating all the preceding names and descriptors and adds his/her name to the end of the growing list.

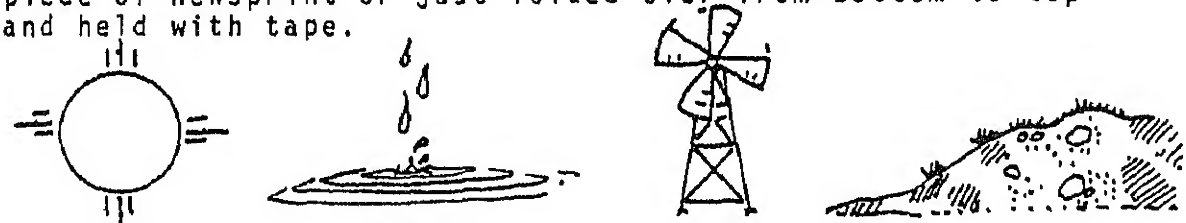
* The game ends when all participants have added their names and have tried to repeat the list.

Step 3. (5 minutes)
When the exercise is completed, introduce the next step: exploring perceptions about appropriate technology and getting to know one another better.

Step 4. (10 minutes)
Ask four people to uncover the symbols that have been posted around the room.

Trainer Notes

Draw symbols for the sun, wind, water and earth. They should be as abstract as possible. Avoid extraneous and possibly interfering or confusing details. The examples should be as simple as possible. The symbols can be covered with a blank piece of newsprint or just folded over from bottom to top and held with tape.



Sun Water Wind Earth

Post the symbols at an equal distance from each other. If
ear each one.

are looking at the symbols, uncover
ge where the following question is

racterizes how you feel right now?

to move around the room, examine
choose one, then move to that area
emselves to others gathered there,
their reasons for choosing that
l.

Step 5. (15 minutes)
After people have had a chance to talk for 10-15 minutes, ask a volunteer from each group to share some of the themes that came out in their discussions.

Step 6. (25 minutes)
Repeat the process using the following question:

Which symbol best represents what Appropriate Technology means to you?

Trainer Notes

If there is a great deal of interest in the small groups, you may choose to let this part go on longer.

As the groups report back,
* encourage brief comments
* make some generalizations about what people said in order to point out that many of them may have the same concerns, and
* relate their ideas to training goals and the program.

Step 7. (10 minutes)
When the groups have finished reporting, ask everyone to get their notebooks and reassemble.

Uncover the third and final question:

What symbol (or set of symbols) best represents your expectations for the training program?

Ask participants to draw the symbol(s) in their notebooks and individually list their expectations for the coming eight weeks.

Step 8. (15 minutes)
Conclude the session by reviewing the objectives and explaining that participants should keep their responses to the final question for later use as reference during an exercise on expectations.

DEFINING EXPECTATIONS OF THE APPROPRIATE COMMUNITY TECHNOLOGY TRAINING PROGRAM

Total time: 2 hours

Objectives:

* To review the content and major themes of the program
* To define and clarify expectations that the participants have of the training program
* To compare and contrast individual expectations with those of the program

Resources:

* "Introduction to the Appropriate Community Technology Training Manual"
* Training Schedule

Materials: Newsprint and felt-tip pens

Trainer Notes

It is important that the training staff participate in this session in order to develop a list of their expectations of the program.

Procedures:

Step 1. (15 minutes)
Briefly outline and explain the session objectives and activities.

Step 2. (5 minutes)
Have participants refer to the symbols and expectation lists that they have in their notebooks (see Session 1, Phase I) and spend a few minutes reviewing them.

Step 3. (30 minutes)
Have participants form small groups in which they discuss their expectations of the program. On newsprint, each group should develop a list of their five most important expectations. Then post the list.

Step 4. (45 minutes)
Reconvene the large group and review each expectation for clarity and understanding. Identify which expectations the training will meet directly, those that

will be touched upon, those which could be addressed with some schedule changes and those, given the practical limitations of the program, which may not be met.

Step 5. (10 minutes)
Distribute copies of the training schedule and the manual introduction. Explain that the manual introduction presents an overview of the program and an orientation to its overall purpose, while the training schedule will give the participants a day-by-day description of the training. Encourage any questions or discussion.

Trainer Notes

n order to make the connection between expectations and how hey will be addressed during the program, it is helpful to efer to specific sessions that deal with the expectations isted by the group.

Step 6. (15 minutes)
Conclude the session by facilitating a discussion centered around the following questions.

* Were any of your expectations changed by this activity?

* Was there something that you learned in this session that you were not expecting during training?

* Is there anything that you have heard about the program that has not been discussed?

Trainer Notes

n addition to clarifying and defining the participant's understanding of the program, this final step helps participants ecide whether or not the program meets their needs.

GROUP RESOURCE ASSESSMENT

Total time: 2 hours

Objectives:

* To share the skills, experiences, knowledge and interests of participants and trainers
* To practice gathering information using active listening and interviewing skills

Materials:

* Newsprint and felt-tip pens
* "Interview Format" on newsprint (See Step 4)

Trainer Notes

In order to promote a sharing of experience among all program participants, it is recommended that the entire training staff engage in this activity.

Procedures:

Step 1. (5 minutes)
Review the session objectives and procedures.

Step 2. (5 minutes)
Present a short talk on the value of a group resource assessment.

Trainer Notes

The talk should include the following points:

* Information gathering will serve as a useful skill during training and as a Peace Corps Volunteer.
* One of the first steps when entering a new community is to gather information about the skills, knowledge and experience of the group members in order to better assess the community's resources.
* By sharing these resources, we will enrich one another's knowledge and experiences.
* During this program we will all be serving in the roles of both trainers and participants at one time or another.

Step 3. (10 minutes)
Have the group brainstorm a list of interview questions which could help assess the group's skills, knowledge, experience and interests.

Trainer Notes

The resulting interview questions should be consolidated or in some other way pared down so that the list does not exceed 4 or 5 open-ended questions that will stimulate conversation.

One way of providing focus during the brainstorm is to post the key points to be included in the interview: skills, knowledge, experience and interests.

Step 4. (5 minutes)
Post and review the interview format.

Trainer Notes

The Interview Format:

Step 1. (5 minutes)
Find someone in the group whom you don't know and move to a comfortable, private location.

Step 2. (30 minutes/15 minutes per person)
Interview one another using the list of questions as guidelines.

Step 3. (10 minutes)
Complete written reports on the interviews.

Step 4. (5 minutes)
On a separate sheet of paper, complete the following statements, using the interview reports as a reference:

* (Name of Person) can be a resource to our group in the following ways . . .

* . . . is interested in finding other group members who . . .

Step 5. (10 minutes)
Share the interview sheets with your partner and make any modifications or additions.

Step 6. (10 minutes)
Post the interview reports and walk around the room scanning the other interview reports and noting any information of special interest.

Step 5. (1 hour, 10 minutes)
Have the participants interview one another.

Step 6. (10 minutes)
Facilitate a discussion of the group's overall impressions of the resources that exist within the training community.

Step 7. (15 minutes)
Conclude the session by asking the following:

* What do you feel that you learned about interviewing from this activity?

* What advantages and disadvantages do you anticipate in using interviews as a way of gathering information in your host country?

Trainer Notes

It is helpful to keep the interview reports posted for several days so that everyone can examine them more closely.

The reports should then be kept in a place where they are accessible and can be used as continuing resources throughout the program.

APPROPRIATE EDUCATIONAL AND LEARNING PROCESSES
PART 1: NON-FORMAL EDUCATION (NFE) AND INTERNATIONAL COMMUNITY DEVELOPMENT WORK

Total time: 2 hours

Objectives:

* To examine the principles of non-formal education
* To discuss ways in which non-formal education may be applied in community work
* To review examples of ways in which non-formal education is used in this training program

Resources:

* "Skills for Development Facilitators" (Appendix A) and the Manual Introduction
* Attachment I-4/1-A, "A Definition of Non-Formal Education"
* Attachment I-4/1-B, "A Comparison of Formal and Non-Formal Education"
* Attachment I-4/1-C, "The Participative and Directive Trainer"
* Srinivasan, Lyra, Perspectives on Non-Formal Adult Learning: Functional Education for Individual, Community and National Development, pp. 1-23

Materials: Newsprint and felt-tip pens

Procedures:

Step 1. (15 minutes)
Distribute Attachments I-4/1-A and I-4/1-B, "A Definition of Non-Formal Education," and "A Comparison of Formal and Non-Formal Education." Read and discuss the definition of NFE found on the attachments.

Step 2. (15 minutes)
Give a brief talk on the background and foundations of NFE and its relationship to adult learning theory. Encourage questions and discussions.

Trainer Notes

For a concise overview of NFE and adult learning theory, refer to: Srinivasan, Lyra, Perspectives on Non-Formal Adult Learning: Functional Education for Individual, Community and National Development, pp. 1-23.

Step 3. (20 minutes)
Have participants identify/discuss some general ways in which NFE concepts might help them in their future role as Peace Corps Volunteers.

Step 4. (15 minutes)
Distribute Attachment I-4/1-B, "A Comparison of Formal and Non-Formal Education," and refer participants to their copies of the Manual Introduction: Skills for Development Facilitators (Appendix A). Briefly explain some of the ways in which NFE is used in this program.

Trainer Notes

Explain how NFE is integrated into the training program through the "Skills for Development Facilitators" and that participants will have opportunities throughout their training to develop and practice NFE techniques and methods. Mention as examples the "Independent Study" and the "Energy Fair" and point out that these opportunities will be introduced in more detail in future sessions. Also, mention that there will be opportunities to facilitate and co-facilitate sessions.

Step 5. (30 minutes)
Have participants form small groups and discuss any additional ways in which NFE concepts may be integrated into the training program.

Step 6. (15 minutes)
Reconvene the large group and have participants share their ideas. Encourage questions and discussion.

Trainer Notes

It is probable that in the course of this discussion certain ideas may be presented which would be of value to the program. You should note these and discuss their feasibility with the training staff.

Step 7. (10 minutes)
Conclude the session by distributing the Attachment I-4/1-C, "The Participative and Directive Trainer." Ask participants to study the list and explain that it will be a resource for the next day's session on the development of facilitation skills criteria.

A DEFINITION OF NON-FORMAL EDUCATION

One definition of non-formal education is that education:

Which takes place primarily outside the school's formal hierarchy which extends from kindergarden to graduate school and

Which is aimed primarily at helping people in such areas as literacy, learning a skill, better farming, better health, better nutrition, etc.

TEN QUESTIONS ABOUT FORMAL AND NON-FORMAL EDUCATION

1. What should be the basis for selecting students to be educated?
   * Formal schools frequently select students because they are already smart and will succeed.

   * Non-formal education is more likely to select students because they have problems and need help.

2. How should curriculum be made? Who should make it?
   * In formal education, curriculum is made by the "experts" in colleges and ministries.

   * In non-formal education, the curriculum arises from the need of the student to know, for example, to increase rice production, limit the size of families or how to run a machine, or prepare a family meal.

3. How should educators be judged on what they do and be accountable for what they do?
   * In formal education we say that the results of our work cannot be known for many years, until the child grows up.

   * In non-formal education the accountability is usually swift and immediate. The illiterate does or does not become literate. The farmer does or does not use a better variety of rice. The housemaker does or does not improve nutrition for her family.

4. How should we evaluate learners?
   * Formal educators like to grade people on the basis of tests and eliminate those who don't make it. We fail them.

   * Non-formal educators are more apt to evaluate people in terms of improvements and not to grade them or sort out on the basis of poor grades.

-Continued-

5. What should be the place of individual competition in education?
   * In formal education competition is on an individual basis, and in comparison to others.

   * In non-formal education, group learning and reinforcement is more apt to be stressed.

6. What is the proper use of time units in education?
   * In formal education we count it in years and think it an accomplishment when we can extend a program from two, say, to four years. As a result a person may now spend more than one-third of his life in school.

   * Good non-formal programs tend to end as soon as the student learns what he needs to know. In fact, some non-formal research indicates that students learn better in short programs than in long ones.

7. Who can teach?
   * In formal education those can teach who are duly certified.

   * In non-formal education anyone can teach who knows what is to be taught and how to teach it.

8. Who can learn?
   * In formal education those who can learn can be admitted.

   * In non-formal education those who have the need to know can be admitted.

9. What should be the role of compulsion in education?
   * In formal education we have many devices for making education compulsory, through laws and curriculum and professional requirements.

   * Most non-formal education is voluntary and people just as easily walk out of the program if they don't think it meets their needs. The student is the judge, not the teacher.

10. At what age do people learn best?
   * In formal education we tend to think that youth is for study and age is for work.

   * Non-formal education frequently mixes youth and age and assumes they can learn if they feel the need to know.

Adopted from Cole S. Brenbeck, "What Can Non-Formal Education Teach Formal Education about Innovation," INNOTECH/NEWSLETTER, Sept/Oct 1977, p. 10.

A COMPARISON OF FORMAL AND NON-FORMAL EDUCATION

Formal Education	Non-Formal Education
A. PURPOSES	
1. Long-term and general Formal education is expected to provide the basis for an individual's whole future life. Therefore (even in technical fields) it is general in character.	1. Short-term and specific Non-formal education meets short-term learning needs of individuals and communities. It therefore emphasizes the learning of specific knowledge and skills and the inculcation of specific attitudes which result in immediately functional behavioural changes.
2. Credential-based The end-product of formal education is the acquisition of qualifications and certificates which enable individuals to obtain specific socio-economic positions in the wider society. Rewards are therefore deferred.	2. Non-credential based Non-formal education produces learning which is immediately valued in the context of the individual's or community's life situation. Rewards are tangible and may include improvements in material well-being, productivity, self-awareness, ability to control the environment, etc.
B. TIMING	
1. Long Cycle Formal education programs are rarely less than one year in length and usually last for much longer periods, often ten years or more. One level of study leads immediately on to the next.	1. Short Cycle Non-formal education programs are quite short, rarely longer than two years and often much shorter than this. Length will depend on the period required to achieve the learning objectives in question.
2. Preparatory Formal education is child-centered and future-oriented and provides the basis for future participation in society and economy.	2.
3. Full-Time Formal education takes place full-time and does not permit other parallel activities, especially productive work.	

C. CONTENT

Formal Education	Non-formal Education
1. <u>Input-Centered and Standardized</u> The basis of the curriculum for formal education is a well-defined package of cognitive knowledge with limited emphasis on psycho-motor or affective consideration. The content is standardized across large groups of learners.	1. <u>Output-Centered and Individualized</u> Non-formal education is task- or skill-centered and designed to produce quite specific changes in the learners. Units are discrete and variable and may be related to the precise functional learning needs of individual participants or small homogeneous groups.
2. <u>Academic</u> The curriculum is founded in theory and isolated from the environmental and social action.	2. <u>Practical</u> The curriculum is dictated by the particular uses to which the learning will be put and consequently is closely related to environment of the learners.
3. <u>Clientele determined by Entry Requirements</u> Clientele are defined in terms of their ability to cope with the level of education being offered. Literacy is essential (except at the lowest level) and successful completion of lower levels is required for admission to higher levels.	3. <u>Entry Requirements determined by Clientele</u> Non-formal education is geared to the needs and interests of the potential clientele. Specific characteristics such as literacy or formal educational qualifications are not essential for admission.

D. DELIVERY SYSTEM

Formal Education	Non-formal Education
1. <u>Institution-based</u> Formal education takes place in highly visible and expensive institutions called "schools," whose sole purpose is educational.	1. <u>Environment-based</u> Non-formal education takes place in a variety of settings but emphasis is given to locales such as the work place or home which are not education-specific. Such specific facilities as are used are minimal and low cost.
2. <u>Isolated</u> Formal education programs are isolated from the socio-economic environment and from social action. Learners are removed from their own environments for substantial periods.	2. <u>Community-related</u> Non-formal education is conducted close to where learners live and work and the environment is functionally related to the learning which takes place.

3. Rigidly structured
Formal education is rigidly structured around the parameters of time and the participants' age and/or performance. It involves uniform entry points, is graded into uniform units, is sequential and continuous. Clear inter-relationships exist between different programs.

3. Flexibly structured
Non-formal education programs have varying degrees and types of structure, but a variety of relationships and sequences is possible within them. Programs are discrete and few relationships exist between them.

4. Teacher-centered
Formal education involves a labor-intensive technology and emphasizes teaching rather than learning. Authority and control is vested in formally qualified and certified members of a teaching profession.

4. Learner-centered
Non-formal education uses a variety of resources and technologies. Emphasis is on learning rather than teaching and a variety of personnel (often not professional educators) are utilized as facilitators rather than teachers.

5. Resource-intensive
Formal education utilizes expensive plant and staff, involves a high opportunity-cost of student time and largely draws its resources from outside the immediate surrounding community.

5. Resource-saving
Non-formal education economizes on resources by utilizing community facilities and personnel (especially at slack times) where possible, by keeping specific facilities low-cost and by part-time study.

E. CONTROL

1. Externally controlled
Curricula and standards are externally determined and publicly controlled or supervised by national bureaucracies.

1. Self-governing
Control is uncoordinated, fragmented and diffuse, involving a variety of agencies, often non-governmental. There is substantial autonomy at program and local levels, with an emphasis on local initiative, self-help and innovation.

2. Hierarchical
Internal control is highly structured and based on role-defined relations among teachers and between teachers and learners.

2. Democratic
Substantial control is vested in participants and the local community.

Adapted from Tim Simkins, NON-FORMAL EDUCATION AND DEVELOPMENT, Monchecter Monographs, 1976, pp. 12-13.

PARTICIPATIVE & DIRECTIVE TRAINING STYLES

The Participative Trainer	The Directive Trainer
1. Involves the trainee in creation or revision of program objectives, and/or the identification of individual learning needs and objectives; strives to keep objectives related to where trainee is and wants to go.	1. Defines objectives for trainee achievement at the beginning of the program; holds to these throughout to maintain consistency and coherence.
2. Assists trainees in identifying possible learning activities and in effectively structuring such activities.	2. Decides what learning activities are most appropriate and expects trainees to follow this structure.
3. Expects the trainee to learn by exploration and discovery, asking questions, making use of available resources and solving problems.	3. Expects the trainee to learn primarily by absorbing material through lectures, readings, etc., by memorization or practice and by responding to trainer questions.
4. Involves the trainees in decision-making; invites ideas, suggestions and criticism from the trainees.	4. Makes the decisions or carries out decisions made by the staff; does not invite suggestions or criticism from the trainees.
5. Structures the training so that unplanned and unexpected problems will be treated as learning opportunities.	5. Follows the schedule closely; avoids problems or dispenses with them quickly so they will not interfere with the planned sequence or schedule.
6. Promotes cooperative work among trainees and climate of openness, trust and concern for others.	6. Promotes individual learning effort, accountability and competition among trainees.
7. Promotes self-assessment by trainees and provides feedback of information needed by trainees to evaluate their own progress.	7. Personally assesses trainee performance and progress, usually through formal tests.
8. Involves the trainees in mid-course or final evaluation of training program, process, materials and its progress toward objectives and elicits suggestions.	8. Does own mid-course or final evaluation of training program and its effectiveness; draws own conclusions about needed revisions.

APPROPRIATE EDUCATIONAL AND LEARNING PROCESSES
PART 2: ADULT LEARNING THEORY AND HOW IT IS USED IN THIS TRAINING PROGRAM

Total time: 2 hours

Objectives:

* To examine different ways that people learn
* To discuss experiential learning as a basic method used in this program
* To examine ways in which the experiential learning model may be applied during Peace Corps service

Resources:

* Attachment I-4/2-A, "Learning Style Inventory"
* Attachment I-4/2-B, "Introduction to Adult Learning Theory"
* Attachment I-4/2-C, De Vries, James, "Extension, Training and Dialogue: A New Approach for Tanzania"
* Ingalls, Andragogy, pp. 1-12
* Srinivasan, Lyra, Perspectives on Non-Formal Adult Learning, pp. 1-23

Materials: Newsprint and felt-tip pens

Procedures:

Step 1. (5 minutes)
Begin the session by reviewing the objectives and providing a brief overview of the procedures.

Step 2. (10 minutes)
Distribute Attachment I-4/2-A, "Learning Style Inventory," and have participants complete it.

Trainer Notes

Explain that the purpose of the inventory activity is to help participants understand and examine ways in which people learn best.

Ask participants not to read the section on scoring until the inventory has been completed.

Step 3. (10 minutes)
Explain the scoring procedure and have participants calculate their scores.

Trainer Notes

Your explanation of the scoring procedures should include a definition of the terms used in the inventory (abstract conceptualization, active experimentation, etc.), and should provide some examples of the meaning of each of the four abbreviations (CE, RO, AC, AE) presented.

Step 4. (10 minutes)
Briefly discuss the group's scores.

Trainer Notes

In order to stimulate discussion, ask if anyone was surprised by his/her scores. Ask for reactions to the inventory.

Step 5. (10 minutes)
Distribute the handout, "Introduction to Adult Learning Theory," and give the participants time to read it.

Step 6. (10 minutes)
Facilitate a discussion of the basic concepts mentioned in the handout by asking how those concepts relate to the four learning styles in the inventory.

Trainer Notes

This discussion should focus on some common characteristics of:

* The experiential learning cycle
* The four learning styles of the inventory
* The basic principles of adult learning
* Non-formal education
* The training approach of this program

A brief talk on these concepts may be included here. Recommended resources include: Ingalls, <u>A Trainer's Guide to Andragogy</u>, pp. 1-12, and Srinivasan, Lyra, <u>Perspectives on Adult Non-Formal Learning</u>, pp. 1-23.

Step 7. (20 minutes)
Distribute the De Vries article and have participants read it.

Trainer Notes

As they read the article, ask participants to keep in mind how the experiential learning approach may be useful in their community work as Peace Corps volunteers.

Step 8. (20 minutes)
After the article has been read, ask participants to:
* Choose one of the objections at the end of the article
* Join a group which has selected the same objection
* Develop a group response to the objection
* Write three key elements on newsprint and post so that all may see it.

Trainer Notes

Point out four corners of the room -- two for trainees choosing objection #1 and two for trainees choosing objection #2.

Step 9. (15 minutes)
Encourage a discussion by asking that a volunteer from each group review and explain the responses developed.

Trainer Notes

Ask for comments concerning any generalizations in order to see how the training methods used here may be applied in the field.

Step 10. (10 minutes)
Conclude the session by reviewing the experiential learning model and explaining that it is the basic model to be used throughout this program.

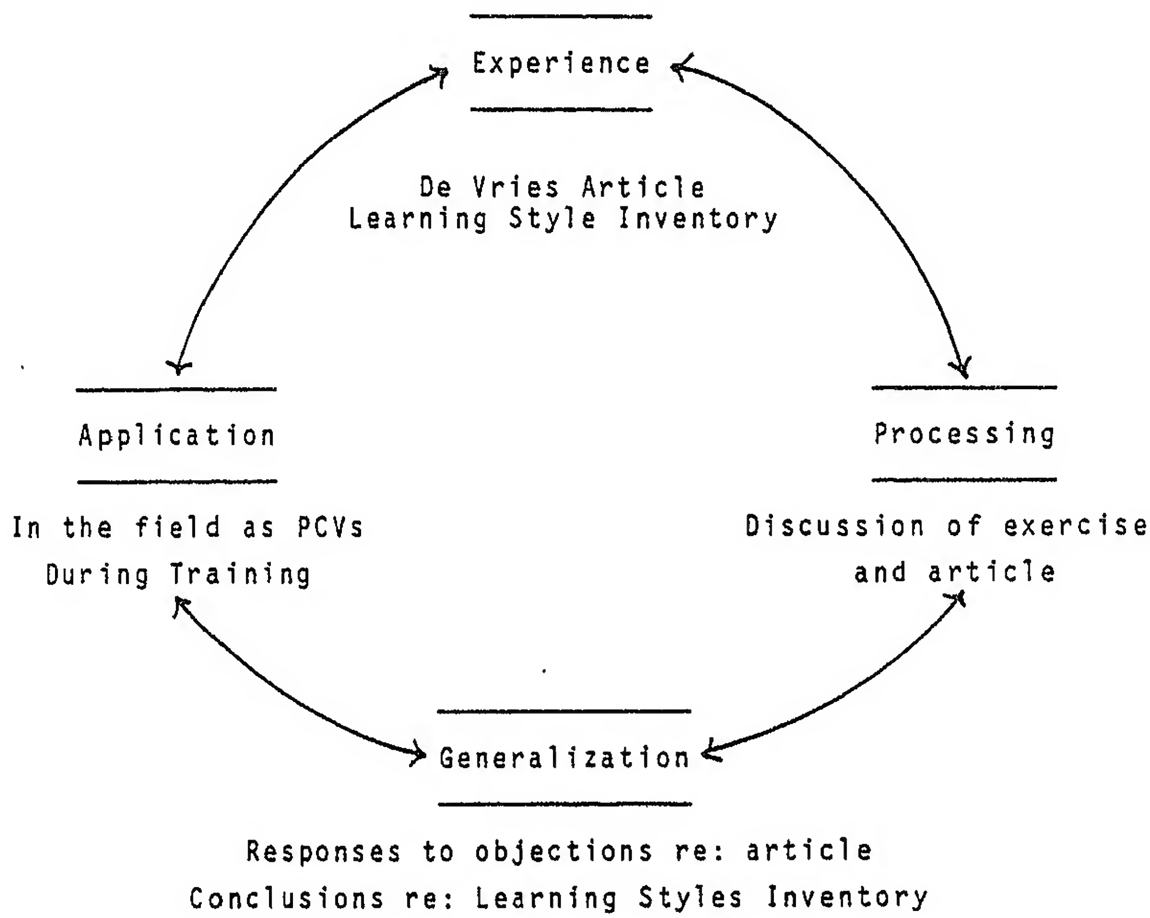
Trainer Notes

As an example, you should post on newsprint a graphic representation of the parallels among the major components of the experiential learning model and the activities carried out in this session.

Continued

Trainer Notes/Continued

The following diagram illustrates:



LEARNING STYLE INVENTORY

This inventory is designed to assess your method of learning. As you take the inventory, give a high rank to those words which best characterize the way you learn and a low rank to the words which are least characteristic of your learning style.

You may find it hard to choose the words that best describe your learning style because there are no right or wrong answers. Different characteristics described in the inventory are equally good. The aim of the inventory is to describe how you learn, not to evaluate your learning ability.

Instructions

There are nine sets of four words listed below. Rank order each set of four words assigning a 4 to the word which best characterizes your learning style, a 3 to the word which next best characterizes your learning style, a 2 to the next most characteristic word and a 1 to the word which is least characteristic of you as a learner. Be sure to assign a different rank number to each of the four words in each set. Do not make ties.

1.	___discriminating	___tentative	___involved	___practical
2.	___receptive	___relevant	___analytical	___impartial
3.	___feeling	___watching	___thinking	___doing
4.	___accepting	___risk-taker	___evaluative	___aware
5.	___intuitive	___productive	___logical	___questioning
6.	___abstract	___observing	___concrete	___active
7.	___present-oriented	___reflecting	___future-oriented	___pragmatic
8.	___experience	___observation	___conceptualization	___experimentation
9.	___intense	___reserved	___rational	___responsible

FOR SCORING ONLY

CE__________	RO__________	AC__________	AE__________
234578	136789	234589	136789

Scoring the Learning Style Inventory

To obtain your score on the four dimensions measured by the inventory, Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC) and Active Experimentation (AE), sum each column including only those words whose item number appears under the place for the total score. For example, for CE, total the ranks you have given for words 2,3,4,5,7 and 8 in the first column. Ignore the nonscored words in each column.

INTRODUCTION TO ADULT LEARNING THEORY

For most of us, the first associations we have to the word "learning" are teacher, classroom and textbook. These associations belie some implicit assumptions that we tend to make about the nature of the learning process. Our years in school have trained us to think that the primary responsibility for learning lies with the teacher. His training and experience make him the expert: we are more passive participants in the learning process. As students, our job is to observe, read and memorize what the teacher assigns and then to repeat "what we have learned" in examinations. The teacher has the responsibility of evaluating our performance and telling us what we should learn next. He sets requirements and objectives for learning since it is often assumed that the student does not yet have the experience to know what is best for himself.

The textbook symbolizes the assumption that learning is primarily concerned with abstract ideas and concepts. Learning is the process of acquiring and remembering ideas and concepts. The more concepts remembered, the more you have learned. The relevance and application of these concepts to your own job will come later. Concepts come before experience.

The classroom symbolizes the assumption that learning is a special activity cut off from the real world and unrelated to one's life. Learning and doing are separate and antithetical activities. Many students at graduation feel,"Now I am finished with learning; I can begin living." The belief that learning occurs only in a classroom is so strong that academic credentials are assigned great importance in hiring and promotion decisions -- in spite of the fact that psychological research has had little success in establishing correlations between performance in the classroom (grades) and success in later life.

As a result of these assumptions, the concept of learning seldom seems relevant to us in our daily lives and work. And yet a moment of deeper reflection says that this cannot be so. In a world where the rate of change is increasing rapidly every year, in a time when few men will end their careers in the same jobs or even the same occupations that they started in, the ability to learn seems an important, if not the most important, skill.

The concept of problem solving, on the other hand, evokes some associations that are opposite to those of the concept of learning. We tend to think of problem solving as an active, rather than a passive, process. Although we have a word for someone who directs the learning process (teacher), we have no similar word for the problem-solving process. The responsibility for problem solving rests with the problem solver. He must experiment, take risks and come to grips with his problem. Usually no external sources of evaluation are needed. He knows when his problem is solved.

Although general principles can emerge from the solution to a specific problem, problems are usually specific rather than general, concrete rather than abstract. Problem solving is not separate from the life of the problem solver. The focus of the problem solving is on a specific problem felt to be relevant to the problem solver; it is, in fact, his involvement in the problem that makes it a problem.

* * *

EXTENSION, TRAINING AND DIALOGUE: A NEW APPROACH FOR TANZANIA

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Journal of Adult Education
University of Dar es Salaam

Extension, Education and Development

Training and extension work with farmers is both an educational effort and a means of development and a part of that development. Before we can begin to criticize traditional training and extension techniques and advocating new ones, it is important to be clear what we mean by development and how training and extension work relate to this goal. Until recently, development was usually defined in economic terms such as changes in the Gross National Product, per capita and economic living standards. Training, and especially agricultural extension, were viewed as an economic development tool; as an investment in human capital on which a return was expected. This implied a directly functional approach to teaching and learning which was focused on "practical" skills and immediate pay-offs.

This view has changed over the past ten years due to concerns about income distribution, dependency on government and other social and political concerns. Now almost every statement about training and development mentions the importance of participation, mobilization, equality and self-determination. Since independence, the party and the Tanzanian government have defined development as liberation. Development is:

> A permanent revolution for the total liberation of the people of Tanzania and Africa from all forms and manifestations of domination, exploitation, oppression, humiliation, weakness, racism, poverty, ignorance, disease and misery (Daily News, 1975)

> For development has a purpose: that purpose is the liberation of man. It is true that in the Third World we talk a great deal about economic development -- but the goods are needed to serve man; services are required to make the lives of men more easeful as well as more fruitful. Political, social and economic organization is needed to enlarge the freedom and dignity of men; always we come back to man -- to liberated man -- as the purpose of the development activity. (Nyerere, 1976)

Development is thus more than a change in material welfare, farming practices or yield per hectare or return per man-day of labor. Development involves changing people, changing their

* Edited by the Training for Rural Development Staff - Tanzania

consciousness or awareness and helping them to become "beings for themselves" -- making their own political, cultural and economic decisions. "The expansion of (man's) own consciousness, and therefore power over himself, his environment and his society, must therefore ultimately be what we mean by development." (Nyerere, 1976)

Education is thus both an end and a means of development. Development which depends on the actions of men requires a change in their consciousness, so that they are the determinant of their own actions. Farmers follow a given practice not because of traditionalism, but because they see it as the best method in the face of their own particular situation. To change these practices either demands force or a change in awareness which convinces them that a different form of action better meets their needs.

Raising the farmers' awareness is the role of both training and extension work. "Adult education has to be directed at helping men and women to develop themselves -- to think clearly -- to examine possible alternative courses of action; to make a choice between those alternatives in keeping with their own purposes; and to equip them with the ability to translate their decisions into reality." (Nyerere, 1976) The "developed" farmer is not the one who is "progressive" or follows the recommended practices (although he or she may do this); rather the developed farmer is the one who is critically aware of his or her situation and acts on it in accordance with this awareness.

The Traditional Approach

Education and extension in Tanzania and other developing countries have received a great deal of criticism. While in part this is unfair because of unrealistic expectations and a failure to see training and extension in the context of other factors influencing development work, much of the criticism is deserved. Part of the blame can be put on the traditional training and extension approaches used in the villages and elsewhere. This approach has [illegible] called the banking, empty cup, directive or top- [illegible] essence is that the trainer or extension [illegible]t who knows (full cup) and tries to give [illegible]bank) this knowledge to the farmer or [illegible]) whose role is to passively receive and [illegible] received from the expert.

[illegible]rlying this relationship is that the trainer [illegible] is good for the farmer or village. Thus, [illegible] vertical and assumes a one-way flow of [illegible] top down. The farmer or villager is seen [illegible] knowledge, traditional and resistant to [illegible] he or she is helpless and must be helped to [illegible]spite of themselves. The farmer or villager [illegible]er, while the trainer or extension agent [illegible]or.

In practice what this boils down to is that the trainer or agent, whether at a meeting, demonstration program or training session, is always in the position of telling villagers what to do. He tries to provide them with solutions to their problems much in the same manner a doctor provides prescriptions to medical problems. In a village one may find a list of the "ten commandments" of good farming posted. In a meeting one will hear the Katibu Kata exhort farmers to weed properly and the Bwan Shamba telling them that eight sprayings of insecticide are necessary to produce good cotton. Farmers rarely raise objections, because they know that such objections are not welcome and often accept the role of the ignorant, passive listener because they are continually told they are. They therefore exist in an oppressive environment over which they exercise little control. If they do object, they are quickly silenced by references to "wataalamu" research and "modern methods" (meaning they are ignorant and traditionalistic) or they need to work (meaning they are lazy). Rather than objecting openly and thus offering to educate the trainers or extension workers and be educated in return, most farmers remain silent. They go home and fail to put into practice what was suggested, even when they may have agreed to do so in the meeting.

The failure of farmers to follow the expert's advice is discouraging to the expert and reinforces the feeling that farmers irrationally resist change. As a result, educators and extension workers tend to work with those few who seem more open to their suggestions -- the "progressive" farmers -- and to advocate the use of pressure to force farmers to use recommended practices for their own good. As one RADO told me, "A farmer who refuses to follow recommended practices is like a sick man: you have to force him to eat and he will thank you for it when he becomes better."

Failure of the Top Down Approach

Unfortunately the farmer often does not become "better" in the sense that he or she obtains a significant benefit from the forced practice. This reveals one of the fallacies underlying the traditional approach: the assumption that all recommended practices are good and that the experts are always right. Experience and research in Tanzania have shown that many practices either recommended to the farmers or forced on them did not benefit the farmers and their rejection of them was quite rational.

Some recent examples are:

1. The use of fertilizer on maize in the lower altitude areas of Morogoro, Tanga and Iringa Region.

2. Growing maize and many other crops in monoculture.

3. Early planting and close spacing of cotton.

4. Production of cotton in many areas of the "Eastern Zone."

Thus, while many recommendations are good, experience has shown that when evaluated from the farmer's perspective, many do not solve the farmer's most pressing needs and are, therefore, unacceptable.

This brings up the second fallacy of the top-down approach: the assumption that farmers and villagers are ignorant. It is true that many of them have little formal education and are illiterate. It is not true that they have learned nothing and know nothing. (It is unfortunate that in Swahili, the same word, ujinga, can be used for both illiterate and ignorant, because the two cannot be equated.) Farmers, through experience and the informal sharing of ideas, have developed a wealth of knowledge about agricultural production and survival in an often harsh environment. They also have a better understanding of their problems, needs, priorities, resources, values, attitudes, local culture, etc. Educators and extension agents tend to be outsiders and members of a different socio-economic class.

Thus, both the extension agent or trainer and the farmer or villager have some knowledge necessary to bring about changes in practices. The scientific knowledge of the researcher needs to be complimented by the more natural knowledge of the farmer to bring about a critical understanding of the problem and the basis for action.

The third major fallacy of the top-down approach is the assumption that knowledge can be given or extended by the trainer and extension agent. Knowledge cannot be poured into the adult learner like tea into a cup. Informed action develops in learners as a result of interaction with information, the situation and fellow human beings. Learning is not an activity of the trainer, but of the learner, and involves a change from one way of understanding or doing something to another. Adults in particular have developed attitudes and ways of doing things. Learning often involves the rejection of existing ideas and acceptance of new ones.

This leads to the importance of understanding the farmer's present knowledge and understanding and these must form the foundation of any new learning. Only an active interaction with ideas and other people can result in the learner really understanding new ideas and making them his or her own, instead of them merely being someone else's ideas.

Finally, another major criticism of the top-down approach, particularly important in the Tanzanian context, is that it builds a dependency relationship between experts (often seen as representing government) and farmers and villagers. It means

presenting the farmers with solutions to their problems, defined in the first place by the experts, instead of analyzing their problems with them, in order to fully understand them, and coming to a solution cooperatively. The traditional approach makes the farmer feel dependent on the continued advice of the trainer or extension agent, as it fails to teach him how to analyze and solve problems on his own. While the government and the party have accepted liberation as the major goal of development, the top-down approach to adult education and extension work encourages dependency and passivity.

Instead of seeing men and women as the end of development, it treats them as a means, tools to be manipulated as efficiently as possible in order to achieve the goals of those in power. In the face of the above, it seems fair to conclude that the present, prevailing approaches to adult education and extension work are not only ineffective but actually are detrimental to the development of Tanzanian farmers and villagers.

The Dialogue Approach

The dialogue approach, illustrated in Table 1, is the opposite of the traditional, top-down approach. Its essence is the horizontal sharing of ideas between trainers/learners, learners/trainers in a process of reflecting and acting on the world in order to understand it and control it better. It is based on faith in people, in his or her ability in cooperation with others, to be able to understand self and situation, and to act on it and change it.

The dialogue approach assumes that both the trainer or extension agent and the student or farmer know something about the subject of interest, especially if the goal is for the learner to apply what is to be learned. Although one may have more general or abstract knowledge and the other may have more informal and specific knowledge, this difference does not make one or the other superior in the situation. It is the shared knowledge both have in the situation which is superior. Within the constraints of each party's environment, each can learn and change as a result of interacting with each other.

While all farmers have some knowledge, they are not always aware of this knowledge. In fact, because they are constantly told that they are backward, lazy, ignorant and thereby made to accept that they are "hopeless," they often feel that they know nothing. When farmers can be drawn out in dialogue as a group, they are often surprised at how much they already know, collectively, about a wide range of production or development problems. It is important, in the beginning, to draw out what the farmers or villagers already know to be able to build on it. As Mwalimu Nyerere points out, by drawing out what the farmers know (which can only be done through dialogue) and showing the relevance of

what is known to what is being learned, the trainer achieves three things:

> He has built up the self-confidence of the man who wants to learn, by showing him that he is capable of contributing. He has demonstrated the relevance of experience and observation as a method of learning to be combined with thought and analysis. He has shown what I call the "maturity" of learning -- that is, by sharing our knowledge, we extend the totality of our understanding and our control over our own lives.

<u>The trainer's role in dialogue is not to present knowledge to the learner but to lead the learner to an examination of problems --to ask the learner to critically reflect and act on problems</u> (problem-posing). Knowledge or learning grow out of this <u>reflection-action cycle</u>. The farmer will never learn the benefit of a practice and the problems associated with it until he has actually tried it and then thought about his experience critically.

Traditional Approach	Dialogue Approach
1. Educators teach and farmers are taught.	1. Educators and farmers are both involved in learning.
2. Experts know everything and the farmers know nothing.	2. Both have knowledge to contribute to joint learning.
3. Educators possess the authority of knowledge and have a monopoly on it -- which they perpetuate.	3. Knowledge is the property of everyone. No one can or should monopolize it.
4. Educators/experts think and farmers are thought about.	4. Farmers are encouraged to think on their own.
5. Educators/experts are active and farmers are passive during learning.	5. Both educators and farmers are active during learning.

<u>Table 1</u>

Neither will the trainer or extension agent know the value of his ideas until he has shared them with the learner and tested them out against the farmer's perceptions and experience. <u>Dialogue thus requires both action and reflection, experience and thought</u>. Without action, teaching is merely verbalism and amounts

to exhorting the farmers to do this or that without showing them how to do it and thus has limited impact on their farming practices. Without reflection, extension work can become mindless activism in which farmers are forced to follow certain practices without understanding them and without the farmers themselves being developed.

Is Dialogue Feasible ?

Let us examine two objections to the use of the dialogue approach often made by extension agents, educators and government officials.

1. The first is that it is impossible to dialogue with farmers or villagers because they know little or nothing about modern agriculture or how to make a village cooperative work.

2. The second objection is that it is too slow and expensive, that our problems need urgent solutions and therefore cannot wait for a long process of dialogue to take place.

DEVELOPMENT OF FACILITATION SKILLS CRITERIA

Total time: 2 hours

Objectives:
* To plan, design and carry out an activity using a training design format
* To identify a list of criteria for evaluating facilitation skills
* To demonstrate skills necessary to be an effective facilitator

Resources:
* "Skills for Development Facilitators" from Manual Introduction
* Attachment I-4/1-C, "The Participative and Directive Trainer"

Materials: Newsprint and felt-tip pens

Trainer Notes

* This activity serves as a "session within a session" and gives the participants an opportunity to develop skills in designing, practicing and evaluating a group activity.
* The design format that is used in this session will be used throughout this program. It can be helpful to Peace Corps volunteers in the design of group activities and workshops on the community level as well.

Procedures:

Step 1. (5 minutes)
Introduce the session by explaining the importance of identifying and using facilitation skills during this program and in Peace Corps service.

Trainer Notes

Emphasize that one of the more important aspects of community work is to provide people with skills to solve problems creatively and in cooperation. This is the essence of good facilitation.

Step 2. (10 Minutes)
Present and explain the training design format.

Trainer Notes

Post the following design format on newsprint:

1. Identify and agree upon objectives.
2. Identify resources.
3. Design or select an activity or activities to meet the objectives.
4. Carry out the activities.
5. Evaluate the activities to see if objectives have been met.
6. Discuss the effectiveness of the process (Steps 1 - 4).

Explain that this training design format will be used in planning, designing, carrying out and evaluating this and other sessions throughout the training program.

Step 3. (10 minutes)
Begin implementing the training design format by reviewing and discussing the session objectives.

Trainer Notes

* The objectives for this session have already been set. Review and discuss them to illustrate the first step of the format.

* It is important that the participants agree that objectives are ones that they want to meet. Otherwise, there is little motivation or reason to meet them. For more background information, refer to Attachment I-4/1-C, "The Participative and Directive Trainer."

* If participants are not satisfied with the stated objectives assist them in modifying them or identifying additional ones.

Step 4. (10 minutes)
Help participants identify resources from within the group (e.g., those who have had experience in group facilitation, training programs, curriculum design, etc.) and make available the resources listed at the beginning of the session.

Step 5. (15 minutes)
Assist in the selection or design of an activity or activities which will meet the session objectives.

Trainer Notes

* Some suggested activities include: brainstorming, discussion, small group meetings, etc.

* Suggest that the procedures of this activity be outlined. Ask that one person keep time, that another observe the way the session progresses and that a third record the facilitation skills criteria as they are identified. (It is important that these criteria be recorded for copying and future distribution. See Step 8, Trainer Notes.)

Step 6. (50 minutes)
Assist participants in carrying out the activity.

Step 7. (10 minutes)
Have participants evaluate the activity.

Trainer Notes

The following questions will help in the evaluation:

* Were the objectives met?
* Was a list of facilitation skills criteria developed?
* Was there active participation by all? Most? Some? Or, just by a few people?
* Were effective facilitation skills demonstrated?
* What went well?
* What was not done well during the activity?

Use the list of criteria developed during the activity to check the skills demonstrated by the facilitator.

Step 8.
Review the training design format and conclude the session.

Trainer Notes

Your review of the format should center around the following questions:

* Does this format have potential for use during Peace Corps service? Why?
* What advantages and/or drawbacks does it have?
* When might it be appropriate? Inappropriate?

Mention that a copy of the criteria will be distributed to all participants and will be used throughout the program for checking facilitation skills.

CROSS-CULTURAL AWARENESS AND COMMUNICATION

Total time: 2 hours

Objectives:

* To experience and examine feelings associated with being in another culture
* To infer meaning from verbal and non-verbal clues
* To examine culturally defined assumptions and perceptions

Resources:

* Batchelder and Warner, "The Albatross," Beyond Experience: The Experimental Approach to Cross-Cultural Education, pp. 131-136
* Shirts, "BaFa-BaFa," (cross-cultural simulation game)

Trainer Notes

The objectives of this session may be met in a variety of ways. The "materials" and "procedures" will depend upon the way in which you choose to meet the objectives.

In the resources listed above, we have suggested two cross-cultural simulation activities that have worked well in the past.

Both the "Albatross" and "BaFa-BaFa" stimulate thought and challenge culturally defined perceptions of what is "right" or "real." Both are simulations, in that they establish cultural and social settings which are artificial and temporary. However, the feelings and ideas that these simulations provoke are very real and not at all artificial. ("BaFa-BaFa" is the more participatory of the two activities. It may also require more than the allowed two hours to implement.)

There are other activities that guide people to examine their perceptions of reality within the context of culture and society. We encourage you to experiment throughout the training program and adapt materials to your specific needs.

In any case, you should be alerted to the fact that this session will require considerable advance preparation in both choosing and setting up the desired activity.

HOLLOW SQUARE

Total time: 2 hours

Objectives:

* To identify and discuss the dynamics involved in planning and implementing a project
* To examine and discuss the kinds of communication that influence the effective and satisfactory completion of a project

Resources:

* Ingalls, Andragogy, pp. 147-154
* Attachment I-7, Toolbox Parts List and Plans
* Pfeiffer and Jones, A Handbook of Structured Experiences for Human Relations Training, Vol. 1, pp. 32-40

Materials: Notebooks and pens and pencils, pre-cut wood pieces for the toolbox (See Attachment I-7), hammers, nails, saws, squares, tape measures.

Trainer Notes

* This activity will help the participants identify the problems that occur when one group makes plans that another group must carry out.
* A diagram of the hollow square can be found in Ingalls, page 151.
* Role descriptions and session procedures can be found in Ingalls, pages 147-154.
* We have found that instead of building a hollow square from paper or cardboard as described in Ingalls, it is useful for the participants to build a toolbox from plywood. The toolbox can then be used during the training program. It is more difficult to construct as it requires some woodworking skills. We have provided a parts list and plans (Attachment I-7) that take the place of the hollow square diagram on page 151 of Ingalls.
* This session requires considerable preparation if a toolbox is to be built, since all of the wood pieces need to be accurately cut and grouped so that there is one set of toolbox pieces for every 7 to 9 participants. It is also helpful, but not necessary, to have one completed toolbox for the participants to use as a model.

Continued

Trainer Notes/Continued

* If a toolbox is to be built, it should be explained to the planners and observers that the words "hollow square" in the instructions should be replaced with the word "toolbox."

* It is recommended that two trainers be involved with this session.

* Remind the planners that they should not use the word "toolbox" or "box" during their instructions to the operators.

Procedures:

Step 1. (5 minutes)
List the objectives and outline the session activities.

Step 2. (5 minutes)
Have the participants form two large groups. Explain that one group will be known as the "planners" and the other group will be the "operators." Have a different trainer go with each group and lead them to separate locations.

Step 3. (5 minutes)
Have each of the two large groups (planners and operators) form small groups. Ask each of the small groups of planners to select one of their members to act as observer.

Trainer Notes

Additional small groups are not necessary if the training group is already small. If you are to build the toolbox, be certain that you have sufficient sets of toolbox parts, one set per group of operators, as well as the necessary tools.

Step 4. (10 minutes)
Distribute the appropriate role descriptions to each group of planners and operators, as well as to each of the observers. Also, distribute the tool box or hollow square parts to each group.

Step 5. (20 minutes)
Have the planners prepare their assembly instructions with the observers noting the process.

Step 6. (10 minutes)
Have the planners present their instructions for assembly to the operators.

Step 7. (30 minutes)
Have the operators assemble the toolbox or hollow square.

Trainer Notes

Explain that the observers should note the group dynamics and progress of the operators. The planners should observe in silence.

Step 8. (30 minutes)
Reconvene the groups and review and discuss the activity.

Trainer Notes

* Ask the observers to report on what they observed during the planning, instruction and assembly.

* Invite observations and discussion from the participants.

* Ask the participants to generalize about what went on in this process, what they learned, what went well, what didn't, etc.

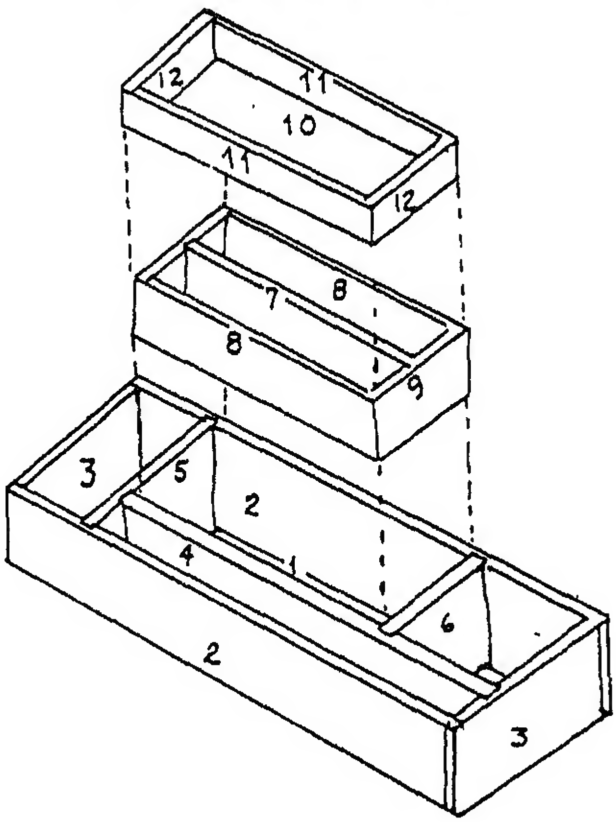
* Encourage the participants to discuss how this exercise might apply to their service as PCVs: Will they be planners? Operators? Observers?

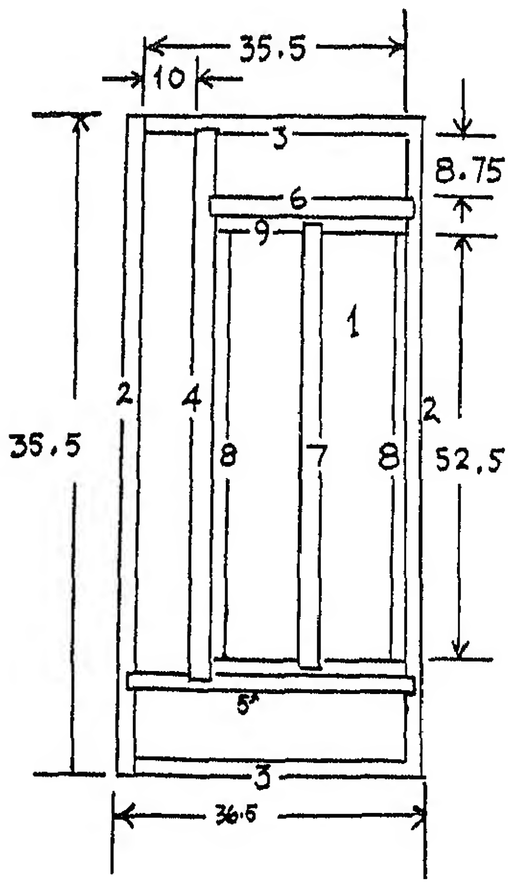
Step 9. (10 minutes)
Have the participants clean up the work area.

TOOLBOX PARTS LIST AND PLANS

Piece No.	Piece Name/Quantity	Length cm	Length in	Width cm	Width in
1.	Box bottom/1	84	33	35.5	14
2.	Box sides/2	86.5	34	20	8
3.	Box ends/2	35.5	14	20	8
4.	Long box divider/1	66	26	19	7.5
5.	Short box divider/1	37	14.5	19	7.5
6.	Short box divider/1	25.5	10	19	7.5
7.	Tray support center/1	53.5	21	12.5	5
8.	Tray support sides/2	52	20.5	12.5	5
9.	Tray support ends/2	24	9.5	12.5	5
10.	Tray bottom/1	51	20	21.5	8.5
11.	Tray sides/2	51	20	5	2
12.	Tray ends/2	24	9.5	5	2

NOTE: All wood is 12mm thick.
All dados are 6mm deep.





HEALTH IN A CROSS-CULTURAL CONTEXT

Total time: 2 hours

Objectives:

* To discuss the term "appropriate technologies for health"
* To share and examine some health beliefs, customs, taboos and practices
* To identify individual perceptions of health, illness and disease
* To define characteristics of "culture shock" and ways to live with it

Resources:

* Werner, Where There is No Doctor, Introduction, pp. 1-15 and 17-19.
* Brownlee, Community, Culture and Care, pp. 173-186
* Audy, "Measurement and Diagnosis of Health"
* Volunteers in Asia, Transcultural Study Guide, pp. 133-138
* Attachment I-8-A, "Introduction and Goals of Health and Nutrition Component"
* Attachment I-8-B, "Culture Shock and the Problem of Adjustment to New Cultural Environments"
* Attachment I-8-C, selections from "Adapting Overseas in the Peace Corps"

Materials: Newsprint and felt-tip pens

Procedures:

Step 1. (10 minutes)
Distribute Attachment I-8-A and review the health and nutrition component of the appropriate technology training program. Invite questions and comments.

Step 2. (20 minutes)
Have participants form small groups and generate a list of health beliefs, customs, taboos and/or practices.

Trainer Notes

Distribute newsprint and felt-tip pens and have each group select a recorder. Each group should also identify one or two beliefs that:

* Are shared by at least two others in the group
* Are held by only one person
* Were held at one time but are no longer
* Have generated much interest in the group
* Are now being doubted

The following comments may clarify the activity: Just as perceptions of health vary from culture to culture, there are often variations within a particular society. We have all grown up with certain beliefs concerning illness and well-being; some of our childhood perceptions are now considered superstitions, tales and quaint customs. There are other beliefs that we still hold as valuable, some of which are considered medically sound, and others for which the origins are forgotten and are of doubtful effectiveness. It is interesting to compare beliefs with those held by other people. Often, what one person considers superstition is another person's inviolable truth.

Encourage a few examples or provide one or two, e.g., feed a cold, starve a fever; don't swim after eating.

Step 3. (20 minutes)
Reconvene the groups and have the recorders post and summarize group responses. Discuss the responses.

Trainer Notes

Focus the discussion by raising the following questions:

* Which beliefs might be appropriate responses for health? Why?
* Where did some of the beliefs originate? Why have they persisted?
* What kinds of illnesses do these beliefs attempt to treat? Can we draw any generalizations?
* Which beliefs might be shared in other cultures?
* Which beliefs seem effective? Neutral? Harmful?

Step 4. (15 minutes)
Present a brief talk on perceptions of well-being. Encourage comments and comparisons with individually held perceptions.

Trainer Notes

Refer to resources for background material. Highlight:

* Early and universal perceptions of balance between body, mind and spirit; imbalance represents illness.

* Early 19th Century perceptions focused on disease and developed "germ theory" to note germs as universal elements causing illness.

* In 1946, the World Health Organization defined health as "a state of complete physical, mental and social well-being, not merely the absence of disease or infirmity."

* Recent ecological perceptions see disease as merely a phase or episode in which the body's ability to cope is diminished; "health is a continuing property, potentially measured by individual ability to rally from environmental insults, whether physical, infectious, social, psychological or chemical." (Audy, page 142)

Step 6. (5 minutes)
Have participants identify some common symptoms which let them know that they are getting sick. Post their responses on newsprint.

Step 6. (5 minutes)
Have the group list feelings and characteristics they have experienced in unfamiliar or uncomfortable situations. Invite the participants to compare the two lists.

Step 7. (20 minutes)
Introduce the term "culture shock" and ask for some definitions and experiences. Distribute Attachments I-8-B and I-8-C and allow time to review the material.

Step 8. (20 minutes)
Review the stages of culture shock and ask for suggestions on how to live with the culture shock experience.

Step 9. (10 minutes)
Review the session and invite observations and comments.

Trainer Notes

Suggest that participants read Werner, pp. 1-15 and 17-19, and Brownlee, pp. 173-186, for additional information.

INTRODUCTION AND GOALS OF HEALTH AND NUTRITION COMPONENT

Introduction

Basic to every society are shared perceptions about well-being and illness that comprise the knowledge applied when a member of the group becomes ill or is believed to be in a vulnerable state of health. Appropriate technologies for health refer to the various means and systems for maintaining or restoring the state of well-being according to cultural norms and realities. Therefore, it is important that the effective overseas development worker accept such health perceptions as valid, integral parts of the culture and respect the tradition they represent. For a development effort to be appropriate, it is crucial that there be an understanding that the concepts and customs regarding health and nutrition are intimately related to every other component of the total culture; there can be no separation of one part from the whole. The issues of development -- including technology, health and nutritional status, participation and integration of women, the role of the overseas worker -- are all inter-related and any change in one area ripples out to affect all others.

It is necessary that a broad background in development issues be provided and that adequate health and nutrition information -- especially in a cross-cultural context -- be made available to future development workers. In a training program that concentrates on alternative and appropriate technologies, the health and nutrition component must reflect deep concern with the relationships between technology and health status and with women and health, particularly the impact of change upon women and children in the developing world and the important role that women play in determining and maintaining family and community well-being.

A health/nutrition education plan should emphasize the cultural relativity of what constitutes appropriate knowledge, attitudes and applications. It should focus as many activities as possible on attaining high-level cognitive skills in order to facilitate providing the type of assistance that fosters community self-reliance and self-determination. Perhaps most important, it should instill the trainee with a sense of understanding how basic and universal is the need to maintain well-being and how connected it is to every aspect of life.

Goals of the Training Plan

Consistent with the health training philosophy established by the Peace Corps for all volunteers, this training plan is based upon the following goals:*

* Stated in the Peace Corps Trainers' Guide for Basic Health Training for all Peace Corps Volunteers (compiled by N. McCharen, OPTC, July 1978)

* To enable volunteers to maintain and promote their own health and well-being while overseas

* To improve the quality of life of the people in the volunteers' communities (based on the WHO definition of health: ". . . a state of complete physical, social and mental well-being and not merely the absence of disease or infirmity.")

* To aid trainees in the development and/or practice of experiential learning processes

* To ensure that trainees fully understand the cultural context of health and disease as it is exemplified both in themselves and in their host communities

* To be sure that volunteers understand that they are not "barefoot doctors"

In addition, certain other goals have been identified as crucial to an integrated training program that emphasizes appropriate technology transfer, community development and the role of women in the development process. These are:

* To provide the trainees with an understanding of the syergetic relationship between health and technology

* To help trainees recognize the important role that women play in maintaining and restoring family and community well-being

* To facilitate the trainees' acquisition of skills and attitudes that encourage community well-being, self-reliance, self-determination and creative problem solving abilities

* To sensitize trainees to the concept that all aspects of a culture are inter-related and must be considered when introducing change in any one component

CULTURE SHOCK
AND THE PROBLEM OF ADJUSTMENT TO
NEW CULTURAL ENVIRONMENTS
from
PAPERS IN APPLIED ANTHROPOLOGY
by

Kalervo Oberg
Cultural Anthropologist
United States Operations Mission to Brazil

I would like today to make a few remarks about culture shock, a malady which I am sure has afflicted most of us here in varying degree. We might almost call culture shock an occupational disease of people who have been suddenly transplanted abroad. Like most ailments, it has its own etiology, symptoms and cure.

Culture shock is precipitated by the anxiety that results from losing all our familiar signs and symbols of social intercourse. These signs or cues include the thousand and one ways in which we orient ourselves to the situations of daily life: when to shake hands and what to say when we meet people, when and how to give tips, how to give orders to servants, how to make purchases, when to accept and when to refuse inviations, when to take statements seriously and when not. Now these cues which may be words, gestures, facial expressions, customs or norms are acquired by all of us in the course of growing up and are as much a part of our culture as the language we speak or the beliefs we accept. All of us depend for our peace of mind and our efficiency on hundreds of these cues, most of which we do not carry on the level of conscious awareness.

Now when an individual enters a strange culture, all or most of these familiar cues are removed. He or she is like a fish out of water. No matter how broadminded or full of good will you may be, a series of props have been knocked from under you, followed by a feeling of frustration and anxiety. People react to the frustration in much the same way. First they reject the environment which causes the discomfort: "the ways of the host country are bad because they make us feel bad." When Americans or other foreigners in a strange land get together to grouse about the host country and its people, you can be sure they are suffering from culture shock. Another phase of culture shock is regression. The home environment suddenly assumes a tremendous importance. To an American, everything American becomes irrationally glorified. All the difficulties and problems are forgotten and only the good things back home are remembered. It usually takes a trip home to bring one back to reality.

Some of the symptoms of culture shock are: excessive washing of the hands; excessive concern over drinking water, food, dishes and bedding; fear of physical contact with attendants or servants; the absent-minded, far-away stare (sometimes called the tropical stare); a feeling of helplessness and a desire for dependence on long-term residents of one's own nationality; fits of anger

over delays and other minor frustrations; delay and outright refusal to learn the language of the host country; excessive fear of being cheated, robbed or injured; great concern over minor pains and eruptions of the skin; and finally, that terrible longing to be back home, to be able to have a good cup of coffee and a piece of apple pie, to walk into that corner drugstore, to visit one's relatives and, in general, to talk to people who really make sense.

Individuals differ greatly in the degree in which culture shock affects them. Although not common, there are individuals who cannot live in foreign countries. Those who have seen people go through culture shock and on to a satisfactory adjustment can discern steps in the process. During the first few weeks most individuals are fascinated by the new. They stay in hotels and associate with nationals who speak their language and are polite and gracious to foreigners. This honeymoon stage may last from a few days or weeks to six months, depending on circumstances. If one is a very important person, he or she will be shown the show places, will be pampered and petted and in a press interview will speak glowingly about progress, goodwill and international amity and if he returns home may well write a book about his pleasant if superficial experience abroad.

But this Cook's tour type of mentality does not normally last if the foreign visitor remains abroad and has seriously to cope with real conditions of life. It is then that the second stage begins, characterized by a hostile and aggressive attitude towards the host country. This hostility evidently grows out of the genuine difficulty which the visitor experiences in the process of adjustment. There is maid trouble, school trouble, language trouble, house trouble, transportation trouble, shopping trouble and the fact that people in the host country are largely indifferent to all these troubles. They help but they just don't understand your great concern over these difficulties. Therefore, they must be insensible and unsympathetic to you and your worries. The result: "I just don't like them." You become aggressive, you bank together with your fellow countrymen and criticize the host country, its ways and its people. But this criticism is not an objective appraisal but a derogatory one. Instead of trying to account for conditions as they are through an honest analysis of the actual conditions and the historical circumstances which have created them, you talk as if the difficulties you experience are more or less created by the people of the host country for your specific discomfort. You take refuge in the colony of your countrymen and its cocktail circuit which often becomes the fountainhead of emotionally charged labels known as stereotypes. This is a peculiar kind of invidious shorthand which caricatures the host country and its people in a negative manner. The "dollar grasping American" and the "indolent Latin American" are samples of mild forms of stereotypes. The use of stereotypes may salve the ego of someone with a severe case of culture shock but it

certainly does not lead to any genuine understanding of the host country and its people. This second stage of culture shock is in a sense a crisis in the disease. If you overcome it, you stay; if not, you leave before you reach the stage of a nervous breakdown.

If the visitor succeeds in getting some knowledge of the language and begins to get around by himself, he is beginning to open the way into the new cultural environment. The visitor still has difficulties but he takes a "this-is-my-cross-and-I-have-to-bear-it" attitude. Usually in this stage, the visitor takes a superior attitude to people of the host country. His sense of humor begins to exert itself. Instead of criticizing, he jokes about the people and even cracks jokes about his or her own difficulties. He or she is now on the way to recovery. And there is also the poor devil who is worse off than yourself whom you can help which, in turn, gives you confidence in your ability to speak and get around.

In the fourth stage, your adjustment is about as complete as it can be. The visitor now accepts the customs of the country as just another way of living. You operate within the new milieu without a feeling of anxiety, although there are momemts of strain. Only with a complete grasp of all the cues of social intercourse will this strain disappear. For a long time, the individual will understand what the national is saying but he is not always sure what the national means. With a complete adjustment, you not only accept the foods, drinks, habits and customs but actually begin to enjoy them. When you go on home leave, you may even take things back with you and if you leave for good, you generally miss the country and the people to whom you have become accustomed.

Now before going on to consider the nature of culture shock, it might be well to point out that the difficulties which the newcomer experiences are real. If individuals come to a tropical area from a temperate one, they quite often suffer from intestinal disturbances. Strange foods sometimes upset people. In Rio, for instance, water and power shortages are very real. When these physical difficulties are added to those arising from not knowing how to communicate and the uncertainties presented by strange customs, the consequent frustrations and anxieties are understandable. In the course of time, however, an individual makes his adjustment. You do what is essential about water, food and the other minutiae of daily life. You adapt yourself to water and power shortages and to traffic problems. In short, the environment does not change. What has changed is your attitude towards it. Somehow it no longer troubles you. You no longer project your discomfort onto the people of the host country and their ways. In short, you get along under a new set of living conditions.

Another important point worth considering is the attitude of others to a person suffering from culture shock. If you are frustrated and have an aggressive attitude to the people of the host country, they will sense this hostility and, in many cases,

respond in either a hostile manner or try to avoid you. In other words, their response moves from a preliminary phase of ingratiation to aggressive ridicule and on to avoidance. As you feel weak in the face of the host country people, you tend to wish to increase your dependence on your fellow countrymen much more than is normal. Some will try to help you; others will try to avoid you. The better your fellow countryman understands your condition, the better he is able to help you. But the difficulty is that culture shock has not been studied carefully enough for people to help in an organized manner and you continue to be considered a bit queer -- until you adjust yourself to the new situation. In general, we might say that until an individual has achieved a satisfactory adjustment, he is not able to fully play his part on the job or as a member of the community. In a sense, he is a sick person with a mild or severe case of culture shock as the case may be. Although I am not certain, I think culture shock affects wives more than husbands. The husband has his professional duties to occupy him and his activities may not differ too much from what he has been accustomed to. The wife, on the other hands, has to operate in an environment which differs much more from the milieu in which she grew up. Consequently, the strain on her is greater.

In an effort to get over culture shock, I think there is some value in knowing something about the nature of culture and its relationship to the individual. In addition to living in a physical environment, an individual lives in a cultural environment consisting of man-made physical objects, social institutions and ideas and beliefs. An individual is not born with culture but only with the capacity to learn it and use it. There is nothing in a newborn child which dictates that he should eventually speak Portuguese, English or French nor that he eat with a fork in his left hand rather than in the right or use chop sticks. All of these things the child has to learn. Nor are the parents responsible for the culture which they transmit to their young. The culture of any people is the product of history and is built up over time through processes which are, as far as the individual is concerned, beyond his awareness. It is by means of culture that the young learn to adapt themselves to the physical environment and to the people with whom they associate. And as we know, children and adolescents often experience difficulties in this process of learning and adjustment. But once learned, culture becomes a way of life, the sure, familiar, largely automatic way of getting what you want from your environment and as such, it also becomes a value. People have a way of accepting their culture as both the best and the only way of doing things. This is perfectly normal and understandable. To this attitude we give the name ethnocentricity a belief that not only the culture but the race and the nation form the center of the world. Individuals identify themselves with their own group and its ways to the extent that any critical comment is taken as an affront to the individual as well as to the group. If you criticize my country, you are criticizing me; if you criticize me, you are criticizing my country. Along with this attitude goes the tendency to attribute all individual

peculiarities as national characteristics. For instance, if an American does something odd or antisocial in a foreign country which back home would be considered a purely individual act, this is now considered a national trait. Instead of being censured as an individual, his country is censured. It is thus best to recognize that ethnocentrism is a permanent characteristic of national groups. Even if a national criticizes some aspect of his own culture, the foreigner should listen but not enter into the criticism.

I mentioned a moment ago that specific cultures are the products of historical development and can be understood not by referring to the biological or psychological peculiarities of its human carriers but to an understanding of the antecedent and concomitant elements of the cultures themselves. Brazil and the United States, for instance, have different cultural origins and different culture histories which account for present day differences. In this case, however, the differences are not great, both cultures being parts of Western civilization. It might be useful to recognize here that the study of culture *per se* is not the study of individuals. Psychology is the study of individual personality. Sociology is the study of groups and group behavior. The student of culture studies not human individuals but the inter-relationships of cultural forms like technologies, institutions, idea and belief systems. In this talk we are interested not so much in the study of culture as such but its impact upon the individual under special conditions.

Now any modern nation is a complex society with corresponding variations in culture. In composition, it is made up of different ethnic groups, it is stratified into classes, it is differentiated into regions, it is separated into rural and urban settlement, each having its distinctive cultural characteristics. Yet superimposed upon these differences are the common elements of official language, institutions and customs which knit it together to form a nation.

These facts indicate that it is not a simple matter to acquaint oneself with the culture of a nation. Similarly, the culture of one's own nation is complex. It, too, differs by region and class. Americans, for instance, who go abroad in various government and business capacities, are usually members of the middle class and carry the values and aspirations of this class, some of which are an accent on the practical or utilitarian work as a means to personal success and suspicion of personal authority. Accustomed to working in large hierarchical institutions like business corporations, governmental agencies or scientific foundations which have a life of their own and persist in time, Americans tend to become impersonal. Individuals, no matter how able, are replaceable parts in these large institutions. To Americans, personalism which emphasizes a special individual, like a political leader or a business leader

or a religious leader as solely responsible for the existence and success of an institution, is somewhat strange. To the American, it is the organization that counts and individual beings judged according to their ability to fit into the mechanism. This difference in inter-personal relationships often comes at least as a minor shock. A new pattern has to be established which has to take into consideration class society, the symbols of individual status, the importance of family relationships and the different importance given work, leisure and the values people strive for.

The rather sketchy remarks I have made here about culture and its elements is for the purpose of showing how important an objective treatment of your cultural background and that of your new environment is for understanding culture shock. There is a great difference in knowing what is the cause of your disturbance and not knowing. Once you realize that your trouble is due to your own lack of understanding of other people's cultural background and your own lack of the means of communication, rather than the hostility of an alien environment, you also realize that you yourself can gain this understanding and these means of communication. And the sooner you do this, the sooner culture shock will disappear.

The question now arises: what can you do to get over culture shock as quickly as possible? The answer is to get to know the people of the host country. But this you cannot do with any success without knowing the language, for language is the principal symbol system of communication. Now we all know that learning new language is difficult, particularly to adults. This task alone is quite enough to cause frustration and anxiety, no matter how skillful language teachers are in making it easy for you. But once you begin to be able to carry on a friendly conversation with your neighbor or to go on shopping trips alone, you not only gain confidence and a feeling of power but a whole new world of cultural meanings opens up for you.

You begin to find out not only what and how people do things but also what their interests are. These interests are usually expressed by what they habitually talk about and how they allocate their time and money. Once you get to know this value or interest pattern, it will be quite easy to get people to talk and to be interested in you. When we say people have no interests, we usually admit the fact that we have not bothered to find out what they are.

At times, it is helpful to be a participant observer by joining the activities of the people, to try to share in their responses, whether this be a carnival, a religious rite or some economic activity.

Yet the visitor should never forget that he or she is an outsider and will be treated as such. He or she should view this

participation as a role playing. Understanding the ways of a people is essential but this does not mean that you have to give up your own. What happens is that you have developed two patterns of behavior.

Finally, a word on what your fellow countrymen can do to help you get over culture shock: It is well to recognize that as the persons suffering from culture shock feel weak in the face of conditions which appear insuperable, it is natural for them to try to lean heavily on their compatriots. This may be irritating to the long-term resident but he should be patient, sympathetic and understanding. Although talking does not remove pain, I think a great deal is gained by having a source of pain explained, some of the steps toward a cure indicated and the assurance given that time, the great healer, will soon set things right.

CULTURE SHOCK

Many people who enter and live in a new culture for more than a month experience what has been labeled "culture shock." This means the newcomer will experience feelings such as not belonging, alienation, unworthiness or inadequacy and may lose touch with his or her own real feelings. In many ways, the person will be experiencing real mental distress but what must be recognized is that culture shock is a normative process. It is something we all may experience to a greater or lesser degree.

We do experience culture shock differently, however. Some people tend to get very depressed. This may mean they withdraw from people of difference and have little energy to put forth in doing anything that is new or requires much effort. They feel victimized and they look at others -- particularly those in the new culture -- as being the cause of their pain and torment.

Others may search desperately for similarities with their own culture or background and then try to rely upon these similarites for support to the exclusion of other activities. Those just out of a university environment may try to recreate some of the dominant qualities of that environment in their new situation. If they were involved in sports, for example, they will try to get involved in similar activities in the new culture. If they previously relied a lot upon books, they will spend much of their time in the new culture simply reading. The tendency is to seek out something familiar from the past in an effort to dominate and exclude the present as well as to preserve one's own ego or sense of identity. This is normal and sometimes, in fact, useful to do.

Old-timers say culture shock can only be lived through, not dealt with. This does not seem to be true if you can just take the first step of recognizing that you <u>are</u> in culture shock. The whole thing is usually so deceptive (and we are so clever at inventing games to screen out the reality) that we cannot or will not admit what we are going through.

If we can get through to our real feelings, the best thing to do is to face the reality and then deal with it. At this point, we can acknowledge that we feel terrible (which is O.K. because it's what everyone feels in a similar situation) and we can look for actions we need to take to overcome these feelings. Action is terribly difficult for people in depression because they feel so ambivalent about things but it is only action that will help. Action cuts through ambivalence and begins to resolve it.

An important question to ask when you recognize that you are feeling "down" and lonely is simply, "What can I do to make myself feel more positive about things?" People in culture shock tend to be very puritanical and demanding of themselves,

ı only heightens the sense of discomfort and inadequacy. Think ıe things that you could do which would be positive first steps. change something which is appropriate to the culture and place ıre in.

)wing are some of the signs that may (but don't always) indi- you're on the old culture shock trip:

ɜarning constantly for certain foods or personal comforts not ɜadily available in the new culture

scaping to maximum structure/minimum contact situations such s movies or formal restaurants

anging around with fellow volunteers or others of your own thnic group

inding yourself talking about "them," "these people" and laming "them" for all the problems you're having in your work r in your personal adjustment

inding yourself drinking excessively or spending unusual mounts of time --

leeping	Daydreaming
ating	Playing cards (especially solitaire)
athing	Reading when you should be doing
rooming yourself	other things

ırganizing (and reorganizing)your room, equipment, etc.

ıvoiding contact with people of the new culture in any of a ıundred other ways which all boil down to one fact: you may ıe in culture shock. You owe it to yourself as well as to :hose around you to start doing something about it.

final note: the term "culture shock" is a very apt and des- ɔtive term. However, it may also imply that there is some- ıg so alien about other cultures that they "shock" newcomers. ɪo not mean to imply that at all. Instead, when an individual ɜrs a different culture, it is often the absence of the taken- -granted, everyday things from the native culture which causes shock. These everyday things can be such items as access to spapers, television, books, friends, certain kinds of foods, . Because these are taken for granted, it may cause discomfort "shock" when they are no longer available, or at least not automatically or in the familiar form. Generally, it is during s period one realizes something is missing or different. ture shock may be experienced before one has substituted and/ accepted new "everyday things" available in the new culture.

Resolving Culture Shock

Simply take note of the conditions present or absent when you experience happiness or discomfort.

THERE IS NO "BEST" ORDERING OF NEEDS.

Nor is the question of why our needs are as they are of any particular importance. In fact, perhaps the most central idea to be conveyed here is that WE SHOULD SATISFY OUR NEEDS, RATHER THAN SUPPRESS THEM.

Any other course of action leads to frustration, unhappiness and even an inability to continue in our roles.

The trick, of course, is to find ways to satisfy our needs in situations where our previous sources and techniques for need-satisfaction are impossible or inappropriate to employ.

Here are a few very general suggestions that many volunteers have found to be practical ways of satisfying their needs in a foreign culture. Check off the ones you think you might do and in the space below each section, list others you may want to try.

* * *

Ways of satisfying the need for affiliation:

_____ Writing letters

_____ Having a love life

_____ Finding a child or group of children to visit

_____ Finding an older person who has the time and patience to talk with you

_____ Going to visit with a close friend

_____ Sports, games, fishing

_____ ______________________________

_____ ______________________________

_____ ______________________________

_____ ______________________________

_____ ______________________________

_____ ______________________________

<u>Ways of satisfying the need for achievement</u>:

_____ Learning anything, especially local cultural information

_____ Doing extra work on the job

_____ Building things/fixing things

_____ Pursuing a creative hobby, such as weaving, musical practice, macrame'

_____ Recording your experiences, photography, creative writing

_____ Studying the language

_____ Doing technical reading, journals, etc.

_____ ____

_____ ____

_____ ____

_____ ____

<u>Ways of satisfying the need for control</u>:

_____ Settling in comfortably, arranging your belongings

_____ Building or acquiring new furniture or equipment for your home

_____ Painting and decorating your living quarters

_____ Making daily schedules, planning and budgeting time

_____ Planning excursions to other places

_____ Arranging to have experiences where you are the center of the activities, such as English lessons, magic tricks, any after-hours teaching or counseling

_____ Seeking out English language environments (preferably with local people)

_____ Finding a good language informant and/or good cultural informant

_____ Finding someone in the village who knows about village plans and will keep you informed

_____ ____

_____ ____

_____ ____

_____ ____

From: ACTION Pamphlet 4200.14, May '76, "Adapting Overseas in the Peace Corps"

COMMUNITY RESOURCE INVESTIGATION
PART 1: METHODS AND MODELS FOR INFORMATION GATHERING

Total time: 1-1/2 hours

Objectives:

* To examine and discuss two community analysis models
* To review information gathering techniques
* To prepare questions and an information gathering strategy for a community visit

Resources:

* Brownlee, Community, Culture and Care, pp. 1-41
* The Farallones Institute, The Integral Urban House, Chapter 2
* Attachment I-9/1-A, "Energy Flow in a Closed System Habitat"
* Attachment I-9/1-B, "The Keeprah Holistic Model"
* Attachment I-9/1-C, "Information Gathering Strategy"

Materials: Newsprint and felt-tip pens

Trainer Notes

This begins a three-part session which can easily take one full day to complete. It is suggested that you post the day's schedule one day prior to the session, so that people can plan accordingly.

Procedures: Step 1. (15 minutes)
Give a brief talk on information gathering.
Invite comments, questions and discussion.

Trainer Notes

Explain that we are constantly gathering information and then filtering it, validating it and analyzing it to provide us with a framework for understanding and decision-making. The first steps in gathering information are the most critical. Describe information gathering as a process that has a series of steps.

Post the following model on newsprint for review:

Continued

Trainer Notes/Continued

Information Gathering Modes

Step 1	Step 2	Step 3	Step 4
Input	Process	Output	Goal
Gather info Convert to: Inferences Hypotheses Guesses	Evaluate info Test inferences Analyze	A working knowledge of how a community operates	To build a development strategy

Explain that we will be focusing primarily on Steps 1 and 2 of the above model since these steps can determine success or failure in our development efforts.

The following comments may be useful in talking about techniques of entering a new community:

* Look and listen.
* Remember, you are a guest.
* Allow time to sensitize to local ways and local ecology.
* Examine support systems: customs, services, technologies.
* Recognize your own biases as filters through which you see.
* Verify information through the process of triangulation (checking information by asking several people the same information).

Step 2. (15 minutes)
Distribute and review Attachments I-9/1-A, "Energy Flow in a Closed System Habitat, and I-9/1-B, "The Keeprah Holistic Model." Invite comments.

Trainer Notes

:ommunity analysis model can help us entering a new community and guide us to seek particular information. Explain that these models are two kinds of "systems" approaches: the Keeprah as sociological and the flow model as more biological. Ask people if they have any experience using community analysis models.

Step 3. (15 minutes)
Distribute Attachment I-9/1-C, "Information Gathering Strategy," and explain the community visit activity.

Trainer Notes

The adjoining community (town, village, neighborhood, etc.) and the training site provide natural settings for community resource investigations. The visits are intended to provide an initial view of a community and are not meant to give an in-depth understanding of all community systems, relationships, needs or concerns.

The community resource investigation will be carried out by information gathering teams. Two teams can be organized to carry out this investigation:

* One team can visit and gather information at the training site (looking at the training site as a community).

* A second team can visit the surrounding community.

Each team should develop a strategy for gathering the information independent of the other. The teams may use the "Information Gathering Strategy," "Energy Flow in a Closed System Habitat," and the "Keeprah Holistic Model" attachments as resources for designing their strategies. However, they should be encouraged to develop their own strategy by adapting the models found in the attachments or inventing their own.

Information gathering strategies should include:

* A community analysis model
* Methodologies to be used
* A list of questions
* A strategy for filtering information through triangulation

Inform the teams they have one hour to develop their strategies and one hour and 45 minutes to carry out the investigation.

Step 4. (30 minutes)
Have the participants form two information gathering teams and develop their strategies for community visits.

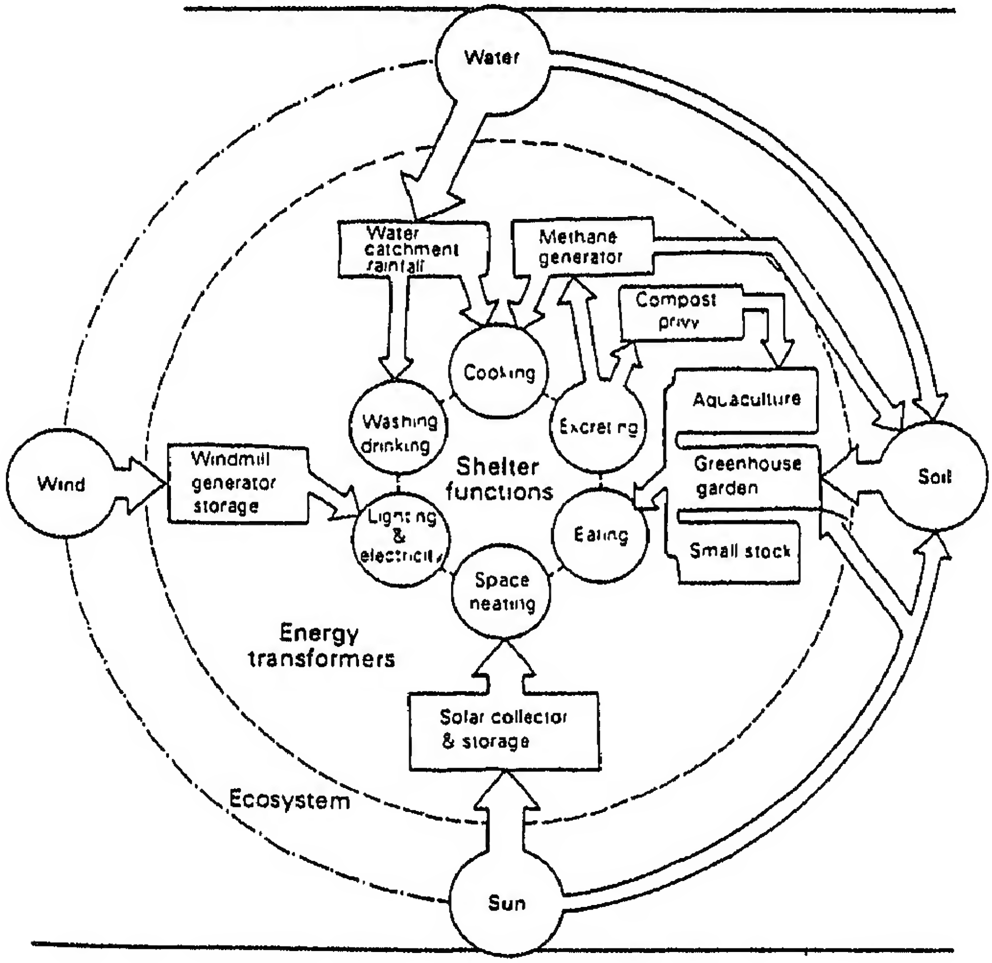
Trainer Notes

You may wish to refer the teams to the session resources for additional background material.

ENERGY FLOW IN A CLOSED SYSTEM HABITAT

A schematic diagram of nutrient and energy cycles in an integral habitat. Note that technology (the middle ring) mediates between ecosystem resources (the outer ring) and human needs and functions (the inner ring).

Energy Flow in a Closed System Habitat



THE KEEPRAH HOLISTIC MODEL

The community analysis model which you will be working with assumes that you can break down a community, for purposes of analysis, into a series of segments, or sub-systems.

Each segment, in the real world, interacts with the other to produce a continual movement and balance which keeps the community alive and moving. Change in one segment can affect another and vice versa. Intervention will do the same. For example, if you introduce improved pig-raising practices by penning up pigs and feeding them, rather than letting them forage for food (an economic intervention), you affect the community health by reducing pig-carried diseases.

Cutting across all segments of the community, you will find that there are common elements. These common elements are defined as:

A. Resources (human, natural and man-made)

B. Problems. Problems are defined as the gap between what is and what should be (what "should be" is often defined culturally).

C. Patterns. Patterns exist which give clues about what is there and how persons perceive them. These patterns of behavior often constitute cultural meaning, as well as biological necessity.

D. Leadership. Among the human resources, you will probably find that leadership exists in many of the sub-areas of the community.

The following model describes this approach to looking at community.

INFORMATION GATHERING STRATEGY

Here is a procedure you may wish to follow in developing your team information gathering strategy:

1. Decide which questions the team considers to be the most important.
2. Consider ways of using the skills and experience of your team members most effectively.
3. Decide whether you will work individually, in pairs or as a team.
4. Look at varying approaches to information gathering and select methods which seem most appropriate.

   For example:

   * Observation
   * Interviews
   * Review of written material
   * Asking questions
   * Flow analysis (sitting in one place and watching what goes on)
5. Develop an approach to validating your information through the use of triangulation.
6. Decide whether or not it would be appropriate to meet at a certain point during the actual information gathering process to revise or modify your strategy.

COMMUNITY RESOURCE INVESTIGATION
PART 2: THE COMMUNITY VISIT

Total time: 2 hours

Objectives:
* To enter and establish rapport with a community
* To carry out an information gathering strategy

Resources: Refer to Part 1.

Materials: As determined by the information gathering teams

Trainer Notes

> Decide whether any special arrangements must be made with the community/ies prior to these visits.

Procedures: Step 1. (15 minutes)
Check with each team to verify the information gathering strategies. Invite comments, questions and discussion.

Trainer Notes

> The trainer notes under Step 3 in Part 1 of this session outline the areas that should be included in the information gathering strategies.

Step 2. (1 hour, 45 minutes)
Have the teams carry out the community visits.

Trainer Notes

> * Be certain the teams know when they should reconvene.
> * The community visits may be followed by the lunch break. Participants may have the option of extending the activity or combining it with lunch.

COMMUNITY RESOURCE INVESTIGATION
PART 2: THE COMMUNITY VISIT

Total time: 2 hours

Objectives:

* To enter and establish rapport with a community
* To carry out an information gathering strategy

Resources: Refer to Part 1.

Materials: As determined by the information gathering teams

Trainer Notes

> Decide whether any special arrangements must be made with the community/ies prior to these visits.

Procedures:

Step 1. (15 minutes)
Check with each team to verify the information gathering strategies. Invite comments, questions and discussion.

Trainer Notes

> The trainer notes under Step 3 in Part 1 of this session outline the areas that should be included in the information gathering strategies.

Step 2. (1 hour, 45 minutes)
Have the teams carry out the community visits.

Trainer Notes

> * Be certain the teams know when they should reconvene.
> * The community visits may be followed by the lunch break. Participants may have the option of extending the activity or combining it with lunch.

COMMUNITY RESOURCE INVESTIGATION
PART 3: ORGANIZING AND PRESENTING THE INFORMATION

Total time: 2-1/2 hours

Objectives:
* To use the four roles for structured meetings
* To organize and present information gathered from the community visit
* To examine and contrast the community analysis models used in the community visits
* To generalize and apply the information gathering experience

Resources:
* Attachment I-1/3-A, "Four Roles for Structured Community Meetings"
* Refer to Part 1 for additional resources

Materials: Newsprint and felt-tip pens

Procedures:

Step 1. (10 minutes)
Present the session objectives and review the session activities. Distribute, review and explain Attachment I-1/3-A. Invite questions and comments.

Trainer Notes

When reviewing and explaining the attachment, mention the following points:

* The group roles described are a particularly effective way of structuring group activities, meetings, etc.
* The process is direct and uncomplicated and has been used with great success by villagers in the Animation Rural Program in French-speaking Africa.
* The information gathering teams will be asked to use this format in this session when giving their presentations.
* These roles will be used throughout the training program.

Step 2. (35 minutes)
Have the information gathering teams organize their information and prepare a presentation.

Trainer Notes

To share this information, explain that the teams should:

* Organize the information and prepare it for presentation.
* Illustrate on newsprint the model used to gather information.
* Prepare an oral presentation involving the participation of each team member.
* Identify a discussion guide, timekeeper, recorder and process observer, as explained in the attachment, to help structure the presentation.
* Distribute newsprint and felt-tip pens to each team.
* Explain that the teams have 50 minutes to prepare their presentations.

Step 3. (45 minutes)
Have the groups give their presentations.

Trainer Notes

Allow for time at the end of the presentations for brief comments, questions and feedback on the success of the presentations. The person identified as "process observer" can also relate impressions.

To focus the discussion on the presentations, ask the participants:

* What did you like most/least about the presentation?
* What did you feel could be improved?
* What suggestions do you have for improvement?

Step 4. (10 minutes)
Have the participants take a short break.

Step 5. (30 minutes)
Reconvene the groups and discuss the survey process.

Trainer Notes

The following questions will help focus the discussion:

* How did your groups function?
* Was there participation by all?
* What types of decision making were used?
* Was there a delegation of roles and tasks?
* What improvements could be made in group process?

Continued

Trainer Notes/Continued

* Did you have to revise your strategies?
* Were the models effective tools for information gathering?
* In what ways do the different models organize information?
* Can you imagine combining the two models? Benefits? Problems?
* What methods of information gathering did you use?
* How did the interviewing go? Did you work in groups or individually?
* Did you use the process of triangulation to verify the information?
* What was the most difficult aspect of this experience?
* What improvements or differences could be made in information gathering methodology?

Step 6. (20 minutes)
Review and discuss the session objectives and activities.

Trainer Notes

Have the participants answer the following questions during the discussion:

* Has this been an effective way to practice information gathering skills and approaches?
* Would this be an effective way to gather information when entering a community in-country?
* What do you think you learned today? Have we met our objectives?
* How has our meeting gone? Has the roles format been useful?
* Can you imagine ways that the role format might be applied in-country?

FOUR ROLES FOR STRUCTURED MEETINGS

1. Discussion Guide: Guides the members through the meeting.
2. Timekeeper: Keeps track of the time.
3. Recorder: Records information for use during the meeting.
4. Process Observer: Watches and reports how members are working together as well as what they are accomplishing.

> NOTE: Group members become stronger as they practice each role. So, rotate all four roles. Stronger members mean more group energy!

Discussion Guide

* Start the meeting at the scheduled time.
* Conduct attunement and "be here now" activities.
* Go around the group to see if everyone is ready to begin the meeting. Take care of individual needs before starting business.
* Be sure the group has a timekeeper, a recorder and a process observer.
* State the purpose of the meeting as you see it. Get an agreement. (If this means changing the purpose, that's all right. Consensus of members about the meeting's purpose or goal has to be reached before proceeding.)
* Reach an agreement on the closing time. Ask the timekeeper to give the group a 10-minute signal before closing time (or whatever warning they want).
* Ask the group to call out tasks to be accomplished in order to reach the goal. Ask the recorder to write them on the chalkboard.
* Assist the members in selecting the order of importance and the time allotted for each task.
* Guide the members in working through the agenda items.
* Ask for the process observer's report.
* End the meeting with attunement or other form of closure.

Timekeeper

* Act as an alarm clock, not as a judge. (That is, alert the others at the times they ask. If members agree on a time extension, be ready to respond to the "resetting." It's all right if tasks are not completed according to plan!)

* If no one else does it, be sure to get the time allotted for each task. (You don't have to do all of the work on time needs if others are willing to share this.)

* Remind the group members near the end of the meeting to save time for the process observer's report.

* Remind; don't reform. Be gentle.

Recorder

* See that a wall chart (or chalkboard) is in everyone's full view. Have marking pens or chalk and eraser ready for use.

* Write agenda items and their priority (order of importance) and the time allotted for each (if the group wants this kind of assistance).

* Keep whatever kind of record the members ask.

* Record the proposals and read them to the group at the end of the meeting.

Process Observer

Watch (like a camera, without judgment if possible) HOW the members work together. Ask for time at the end of the meeting to give your answers to the following questions:

* Did the members all agree on the meeting's goal?
* Was the style of leadership appropriate for the task?
* Was the timekeeping effectively carried out?
* Was recording, as needed, effectively carried out?
* Did members show feelings of friendliness and trust?
* Did everyone participate in some way?
* Did members reach their goal or, if not, did they understand why not?

On a scale of 1 to 10, rate the success of the group life (apart from the group task):

1 2 3 4 5 6 7 8 9 10!

Remember that you can take part in the meeting as well as observe it!

AN EXERCISE IN PROBLEM SOLVING: FORMULATING A PLAN FOR WELL-BEING

Total time: 2 hours

Objective:

* To develop a comprehensive plan to maintain and restore well-being during training and future Peace Corps service
* To resolve a current concern or problem using the OFPISA model

Resources:

* Ingalls, John, Andragogy, pp. 38-45 & 145-146
* Pfeiffer, John and J. Jones, A Handbook of Structured Experiences for Human Relations Training
* Samuels and Bennett, The Well Body Book, pp. 1-15 & 105-112
* Werner, David, Where There is No Doctor, pp. 233-244 & 140-216
* Attachment I-10-A, "The OFPISA Problem-Solving Model"
* Attachment I-10-B, "Problem-Solving Worksheet"

Materials: Newsprint, felt-tip pens, paper, pens, session objectives written on newsprint and posted

Procedures:

Step 1. (5 minutes)
Review the objectives and present the OFPISA problem-solving model. Distribute Attachment I-8-A to be read.

Step 2. (15 minutes)
Ask participants to suggest a sample concern common to the training group (e.g., loneliness, sickness, food, not enough research time). Then, following the OFPISA format, encourage them to work through the problem as you note information about it on the newsprint or board.

Step 3. (60 minutes)
Distribute the problem-solving worksheets, Attachment I-8-A, and have participants practice using the OFPISA model to identify and attempt to resolve a current concern or problem that relates to personal well-being.

Trainer Notes

Explain that it is important for participants to work in pairs in order to effectively address one another's concerns.

Step 4. (15 minutes)
Meet with the entire group and elicit observations and questions about the activity and the problem-solving model.

Step 5. (15 minutes)
Based on the OFPISA format, have participants develop a comprehensive plan for well-being that will be of use during training and Peace Corps service. Explain that the plan is to be completed as a homework assignment sometime before mid-program.

Trainer Notes

* Explain that the plan is a method for putting into practice material which will be discussed in health and nutrition sessions during the first half of the program and that such a plan provides an opportunity to identify and clarify one's definition of and approach to well-being.

* It is important to stress that the plan may take many forms (e.g., a graphic flow chart, a written report, a cassette tape, etc.).

* The plan should include:
  1. mental, physical and emotional components
  2. potential problems or concerns that must be resolved for improved health
  3. ways in which specific health problems will be resolved (e.g., treat alone, use an indigenous practitioner, go to a doctor)

* Questions to be answered:
  1. What are the symptoms of illness?
  2. What are the characteristics of good health?
  3. What lifestyle changes are necessary to promote better health?
  4. What illnesses or diseases are likely during training or Peace Corps service?

Step 6. (5 minutes)
Assign the readings in Werner (pp. 140-216 and 233-244) and in Samuels and Bennett (pp. 1-15 and 105-112) as resource material for the plan development.

Step 7. (5 minutes)
Discuss any questions concerning the exercise and set a date (prior to mid-program) for reviewing the plans.

THE OFPISA PROBLEM SOLVING MODEL

Buckminster Fuller said that a problem well stated is a problem solved. In order to state a problem completely and well, as much relevant information as possible must be gathered. The following model is designed to assist in the definition of the problem, the examination of all its aspects and an acceptable resolution to the conflicts and challenges presented by it.

In the model, first the original problem is stated. This may also be a goal, objective or issue.

Then, the factors relating to the problem are listed. The problem may be defined as a temporary equilibrium between factors that move toward change and those that restrain it. In order to solve the problem, the equilibrium or tension must be broken. The equilibrium may be likened to a force field: the problem is held static between opposing forces that push and pull. All factors are listed that have any bearing on the problem. One list notes the driving forces toward resolution and another notes factors that serve as restraining forces. The journalistic "w's" are useful in identifying the factors: who, what, why, where, when and how.

The problem redefined or restated is considered next. After all the factors both for and against resolution are identified, the real problem may emerge. This may be a simple restatement of the original problem or it may be another problem entirely, based on new information provided by examining the various factors.

Many and different ideas are generated by brainstorming: all ideas, suggestions and possible solutions are listed without discriminating among them. These serve to either increase the forces driving towards resolution or decrease the restraining forces. The brainstormed list may be comprised of logical, sensible ideas as well as those that seem crazy or not at all feasible. It should be remembered that most of the important or major inventions of the world had their origin in a "strange" idea that somehow worked! Therefore, judgment should be suspended during this phase and all creative suggestions listed, regardless of their initial appearance.

To devise a solution to the problem, a selection and comparison of the various ideas are made, thereby generating concrete and potentially viable solutions.

Each potential solution is evaluated to determine its acceptance by those affected by it. If the solution is not acceptable, another solution must be tried. If it is viable, then it is implemented and the problem has begun to be resolved.

One way of remembering this model is to term it the OFPISA (as in the leaning tower):

O - Original problem

F - Factors

P - Problem redefined

I - Ideas

S - Solutions

A - Acceptance

From CHP International, Inc., Staff Training Materials.
707B Davis Rd., Elgin, IL 60120)

PROBLEM SOLVING WORKSHEET

O - Original Problem

F - Factors: Driving Forces Restraining Forces

P - Problem Restatement

I - Ideas

S - Solution

A - Acceptance

From CHP International, Inc., Staff Training Materials.
707B Davis Rd., Elgin, IL 60120)

COMMUNICATION AND LISTENING SKILLS

Total time: 2 hours

Objectives:
* To practice giving and receiving feedback
* To prepare for counterpart sessions
* To practice active listening skills
* To discuss impressions of the training program to date

Resources:
* Attachment I-11-A, "Feedback and the Helping Relationships"
* Attachment I-11-B, "Johari Window"
* Ingalls, Andragogy, pp. 164-174

Materials: Newsprint and felt-tip pens

Procedures: Step 1. (10 minutes)
Facilitate a discussion of the training program to date.

Trainer Notes

Ask for impressions of the overall program, or one aspect of it, or ask about any difficulties people have experienced in the new environment of Peace Corps training.

Step 2. (15 minutes)
Distribute Attachment I-11-A and review it with the group, highlighting different aspects of giving and receiving feedback.

Trainer Notes

Refer to Andragogy, pp. 164-174, for background information on communication and consultation skills. The following distillation of that material may also be used in your explanation:

* Effective communication underlies all mutually supportive relationships -- in personal life, in the work environment, and in formal as well as informal counseling situations. However, it takes practice to develop the skills necessary for helpful, non-threatening interactions.

Continued

Trainer Notes/Continued

* Perhaps the most important aspect of counseling is to be a good listener: that is, one who listens actively, knows how to interview unobtrusively and can provide accurate feedback to the person being interviewed.

* Interpersonal communication involves complex dynamics on both the verbal and non-verbal levels. If there is distortion in either sending or receiving the intended message, then misunderstanding and a breakdown in communications will result.

* A method of reducing distortion is called "feedback." This happens when a person responds to the sender of a message in a way that expresses how it was received. It is important to realize that feedback must be natural, not forced or imposed, and it must be based on mutual trust in order to be non-threatening.

* Feedback reflects perceptions of behavior and is only a measure of the way in which a situation is viewed. It should be clear, specific and related to the situation at hand. It should be descriptive and potentially helpful in a way that the receiver may decide either to use it or not.

* Feedback serves to clarify communication so that the helping relationship is enhanced through accurate perceptions of the concerns and problems being discussed.

Step 3. (15 minutes)
Distribute Attachment I-11-B, "Johari Window," and review it with the participants.

Trainer Notes

Explain that the Johari window model is instrumental in providing a framework for the continuing exercises in giving and receiving feedback. The model has been helpful in keeping the "feedback" theme in perspective and in encouraging the use of feedback as a constructive technique for building awareness, trust and communication skills.

Step 4. (10 minutes)
Present a demonstration of the feedback activity to be carried out in Step 5.

Trainer Notes

This demonstration step is considered optional. However, it has been found that when participants have the opportunity to see

Continued

Trainer Notes/Continued

and discuss a demonstration prior to beginning the activity in Step 5, they are more likely to understand the procedures and guidelines.

The procedures for carrying out the demonstration are as follows:

* Ask for two volunteers to help you demonstrate active listening skills.

* Place three chairs in the center of the room where they may be easily seen by all.

* Ask one volunteer to speak briefly (about 30 seconds) about an aspect of the training program that is most or least appealing.

* Ask the other volunteer to be an observer and to interrupt in 30 seconds.

* Try to paraphrase what the first volunteer has said.

* Ask the speaker if the paraphrase was accurate.

* Ask the observer about the accuracy of the paraphrase and for any observations about techniques and factors that either helped or hindered the communication: e.g., eye contact, body language, apparent sincerity.

* Ask if there are any observations from the rest of the group.

* At the end of the discussion, have another volunteer take your place. Then repeat the process with the three volunteers changing roles.

Step 5. (30 minutes)
Explain the guidelines and procedures of the feedback activity. Have participants divide into groups of three and carry it out.

Trainer Notes

Explain that this activity is designed to help build active listening skills, to provide practice in giving and receiving feedback and to sharpen skills in observation and paraphrasing.

Continued

Trainer Notes/Continued

There are three roles for each of the three group members: a listener, a person giving feedback or expressing a concern and an observer/timekeeper.

The procedures for carrying out the activity are as follows:

* One person speaks for 30 seconds as in the demonstration.

* Another listens carefully and provides a repetition or paraphrase of what has been said.

* A third observes the interactions between the two on both the verbal and non-verbal levels and interrupts at 30 seconds.

* The speaker gives feedback on the accuracy of the paraphrase.

* The observer shares what has been noticed about the interaction, giving feedback to the speaker and listener.

* The roles change until everyone has had the opportunity to be in each position.

Step 6. (10 minutes)
Have the entire group meet to discuss the activity.

Trainer Notes

Some questions to stimulate this discussion include:

* What factors or behaviors helped you give and receive feedback?

* What behaviors or characteristics made you feel understood or misunderstood by the listener?

* Why are active listening skills important during training and Peace Corps service?

* What problems and solutions were discussed? Was there any resolution of differences or concerns?

FEEDBACK AND THE HELPING RELATIONSHIP*

Some criteria for useful feedback:

1. It is descriptive rather than evaluative. By describing one's own reaction, it leaves the individual free to use it or not to use it as he/she sees fit. By avoiding evaluative language, it reduces the need for the individual to react defensively.

2. It is specific rather than general. To be told that one is "dominating" will probably not be as useful as to be told that "just now when we were discussing the issue you didn't listen to what others said and I felt forced to accept your arguments or face an attack from you."

3. It takes into account the needs of both the receiver and the giver of feedback. Feedback can be destructive when it serves only our own needs and fails to consider the needs of the person on the receiving end.

4. It is directed toward behavior which the receiver can do something about. Frustration is only increased when a person is reminded of some shortcoming over which he has no control.

5. It is solicited, rather than imposed. Feedback is most useful when the receiver him/herself has formulated the kind of question which those observing him/her can answer.

6. It is well-timed. In general, feedback is most useful at the earliest opportunity after the given behavior (depending, of course, on the person's readiness to hear it, support available from others, etc.).

7. It is checked to insure clear communication. One way of doing this is to have the receiver try to rephrase the feedback he/she has received to see if it corresponds to what the sender had in mind.

8. When feedback is given in a group, both giver and receiver have opportunity to check with others in the group the accuracy of the feedback. Is this one person's impression or an impression shared by others?

Feedback, then, is a way of giving help; it is a corrective mechanism for the individual who wants to learn how well his/her behavior matches the intention and it is a means for establishing one's identify -- for answering "who am I?"

* Taken from the Reading Book: Laboratories in Human Relations Training, Washington, D.C.: NTL Institute for Applied Behavior Science, associated with the National Education, 1969.

APPENDIX A:

SKILLS FOR DEVELOPMENT FACILITATORS

SKILLS FOR DEVELOPMENT FACILITATORS

I. Taking Preparatory Steps

In the preliminary stage of collaboration with a community or other group of people, the facilitator should:

A. Understand and be able to articulate his or her:

1. Motivation
2. Expectations of the experience
3. Strengths and weaknesses
4. Role as a facilitator
5. Individual values

B. Be sensitive to and able to identify:

1. Expectations of the local community or other group
2. Local culture and resources, including customs, values, knowledge and ways of life

C. Communicate in ways that demonstrate:

1. Active listening and observation skills
2. An ability to filter information
3. Skill in working cooperatively and in collaboration with others
4. An understanding of the participatory approach to development
5. An ability to synthesize and articulate information in ways that promote local self-reliance, integrity and well-being

D. Utilize appropriate on-going techniques for evaluating the preliminary stages of involvement

II. Establishing a Dialogue

In the next stage of involvement, the facilitator should:

A. Demonstrate skills in facilitation and organization that include:

1. An ability to work with existing local social structures and groups
2. Stimulating active local participation
3. Motivating others to contribute their skills and knowledge
4. Planning and facilitating meetings, when appropriate
5. Sharing techniques for effective problem solving, team building and negotiating

B. Be able to examine, analyze and prioritize issues, concerns and needs within the local context

II. C. Understand and be able to articulate development issues in relation to local problems and strategies for change

D. Continue to develop skills in interpersonal communication, including:

1. Encouragement of local leadership, when appropriate
2. Building trust and confidence
3. Consultation (e.g., active listening, conferring and feedback)

E. Use on-going and appropriate techniques to evaluate the use of dialogue in community work

III. Planning with the Community

In planning for active community participation, the facilitator should:

A. Collaborate with the local cummunity or group to identify:

1. Needs
2. Resources
3. Goals and objectives
4. Potential problems or limiting factors

B. Assist in the establishment of:

1. Project criteria
2. Plan of action
3. Methods of project documentation
4. Relationships with appropriate organizations and agencies to form a supportive network

C. Articulate the manner and extent of his or her involvement of the development process

D. Use on-going evaluation methods to review the planning stage

IV. Using the Dialogue Approach

Throughout the stages of community involvement, the facilitator should:

A. Demonstrate an understanding of non-formal education through the use of:

1. A variety of communication techniques
2. Problem-solving activities
3. Methods that motivate others to actively participate in the education process

IV. B. Stimulate project implementation through the use of local skills, knowledge and resources during:

1. Development and/or construction
2. Adaptation and modification
3. Utilization
4. Project review

C. Use on-going methods of evaluation to ensure that project implementation is consistent with the participatory approach to development

V. <u>Evaluating the Process</u>

In order to learn from, and improve upon the experience of working with a community or other group, the facilitator should:

A. Collaborate in the establishment and use of appropriate evaluation criteria and techniques.

B. Use a continuing process of evaluation to:

1. Review the level of local participation
2. Review methods and approaches used during development work
3. Assess the level of local self-reliance and well-being
4. Analyze each phase of development work
5. Generalize and apply the knowledge gained to improve the participatory approach to development

APPENDIX B:

TWO-WEEK WORKSHOPS

<u>Two-Week Workshops</u>:

EARTHEN CONSTRUCTION AND FUEL-SAVING COOKSTOVES

PEDAL/TREADLE POWER

SOLAR WATER HEATERS

SOLAR AGRICULTURAL DRYERS

The following calendar pages represent a suggested format for converting each of the four technical phases of this program into independent two-week workshops. In addition to technical sessions, each workshop contains selected core sessions related to training methodology, the role of the volunteer in development, health and nutrition, independent study, appropriate aids to communication and evaluation.

In designing each workshop, overseas trainers should consider the following recommended guidelines:

* Review the entire manual carefully and choose core sessions which meet country-specific needs.

* Wherever necessary, modify individual session procedures to account for the two-week format.

* As a basic reference in carrying out all suggested group dynamics activities, refer to Phase I: Session 12, "Construction of Earthen Block Molds - A Focus on Group Dynamics."

* Review Phase I: Session 4, "Appropriate Educational and Learning Processes," and Phase I: Session 5, "Development of Facilitation Skills Criteria," and modify the procedures for both sessions so the objectives can be met in a four-hour time period.

EARTHEN CONSTRUCTION AND FUEL-SAVING COOKSTOVES (Week One)

	DAY 1	DAY 2	DAY 3
A.M.	Sharing Perceptions of Appropriate Technology: An Ice Breaker/ Phase I: Session 1	Global Energy Issues/ Phase I: Session 14	Traditional Methods of Cooking: An Introduction to Cookstove Technologies/ Phase II: Session 2
A.M.	Defining Expectations of the Community Technology Training Program/ Phase I: Session 2	Construction of Earthen Block Molds - A Focus on Group Dynamics/ Phase I: Session 12	Fuel-Saving Cookstoves: Gathering Information/ Phase II: Session 3
P.M.	Group Resource Assessment/ Phase I: Session 3		Cookstove Design and Innovation/ Phase II: Session 4
P.M.	Hollow Square/ Phase I: Session 7	Construction of Earthen Blocks/ Phase I: Session 13	Introduction to Independent Study/ Phase II: Session 6

	DAY 4	DAY 5	DAY 6
A.M.	Appropriate Educational and Learning Processes, Parts 1 and/or 2 (Option)/ Phase I: Session 4	Cookstove Operation, Function and Design Principles/ Phase II: Session 7	Cookstove Construction (continued)/ Phase II: Session 10
A.M.	Development of Facilitation Skills Criteria (option)/ Phase I: Session 5	Understanding the Cookstove Design Process and Soil Mixes/ Phase II: Session 8	
P.M.	Environmental Health and Sanitation/ Phase II: Session 1	Cookstove Construction, Parts 1, 2 and 3/ Phase II: Session 10	
P.M.	The Role of the Volunteer in Development: The Definition of Appropriate Technology/ Phase II: Session 13		

EARTHEN CONSTRUCTION AND FUEL-SAVING COOKSTOVES (Week Two)

	DAY 7	DAY 8	DAY 9
A.M.	Cookstove Construction (continued)/ Phase II: Session 10 Use of Appropriate Aids to Communication/ Phase III: Session 6	Volunteer in Development: Part 1: Women in Development/ Phase III: Session 19 Maternal and Child Health, Part 1/ Phase III: Session 1	Basic Nutrition/ Phase II: Session 23 Other Responses to Fuel Scarcity/ Phase II: Session 18 Charcoal Production and Stoves/ Phase II: Session 19
P.M.	Stove Promotion and Dissemination/ Phase II: Session 14 Independent Study Explaining Completed Cookstoves/ Phase II: Session 15	Evaluating Cookstove Efficiency/ Phase II: Session 16 Diagnosing and Repairing Malfunctioning Cookstoves Parts 1 and 2/ Phase II: Session 17	Design and Construction of the Second Stove, Parts 1, 2 and 3/ Phase II: Session 21

	DAY 10	DAY 11	DAY 12
A.M.	Design and Construction of the Second Stove (continued) Phase II: Session 21 Independent Study and Clean-Up Alternative Cookstoves Presentations/ Phase II: Session 22	Cookstove Operation, Parts 1 and 2/ Phase II: Session 24	Cookstove Information Resources, and Evaluating Cookstove Training/ Phase II: Session 26 Evaluation and Integration of Training Themes, Parts 1, 2 and 3/ Phase I: Session 16
P.M.	Issues and Methods in the Development and Diffusion of Appropriate Technology/ Phase V: Session 11	Cookstove Development and Innovation/ Phase II: Session 25 Appropriate Technologies for Health/ Phase III: Session 13	

PEDAL/TREADLE POWER (Week One) TWO-WEEK WORKSHOP - Page 1

	DAY 1	DAY 2	DAY 3
A.M.	Sharing Perceptions of Appropriate Technology: An Ice Breaker/ Phase I: Session 1 Defining Expectations of the Community Technology Training Program/ Phase I: Session 2	Global Energy Issues/ Phase I: Session 14 Appropriate Educational and Learning Processes, Parts 1 and/or 2 (option)/ Phase I: Session 4	The Role of the Volunteer in Development: The Definition of Appropriate Technology Phase II: Session 13 Design Considerations for Pedal/Treadle/ Phase III: Session 4
P.M.	Group Resource Assessment/ Phase I: Session 3 Hollow Square/ Phase I: Session 7	Development of Facilitation Skills Criteria (option)/ Phase I: Session 5 Introduction to Pedal/ Treadle Power/ Phase III: Session 3	Classical Mechanics: Principles of Pedal/ Treadle Power/ Phase III: Session 5 Use of Appropriate Aids to Communication/ Phase III: Session 6

	DAY 4	DAY 5	DAY 6
A.M.	Food Issues/ Phase II: Session 12 Part 1: Familiarization with Parts and Tools, Part 2: Familiarization with the Bicycle (option) Phase III: Session 8	Presentation of Designs/ Phase III: Session 10 Introduction to Independent Study/ Phase II: Session 6 Independent Study	Construction of Pedal/Treadle Devices/ Phase III: Session 11
P.M.	Introduction to Design/ Phase III: Session 9	Maternal and Child Health, Part 2/ Phase III: Session 7 Volunteer in Development: Part 1: Women in Development/ Phase III: Session 19	

	DAY 7	DAY 8	DAY 9
A.M.	Construction of Pedal/ Treadle Devices (continued)/ Phase III: Session 11	Construction of Pedal/ Treadle Devices (continued)/ Phase III: Session 11	Construction of Pedal/ Treadle Devices (continued)/ Phase III: Session 11
P.M.	Basic Nutrition/ Phase II: Session 23	Issues and Methods in the Development and Diffusion of Appropriate Technology Phase V: Session 11	Wind Technology/ Phase IV: Session 12

	DAY 10	DAY 11	DAY 12
A.M.	Blacksmithing and Metalwork/ Phase III: Session 12 Construction of Pedal/ Treadle Devices (continued)/ Phase III: Session 11	Case Studies in Community Health/ Phase III: Session 14 Independent Study	Independent Study and Clean-Up Evaluation and Integration of Training Themes, Parts 1, 2 and 3/ Phase I: Session 16
P.M.	Preparation for Pedal/ Treadle Presentations/ Phase III: Session 15	Presentation of Pedal/ Treadle-Powered Devices/ Phase III: Session 18	

	DAY 1	DAY 2	DAY 3
	Sharing Perceptions in Appropriate Technology: An Ice Breaker/ Phase I: Session 1	Introduction to Solar Water Heaters/ Phase IV: Session 2	Appropriate Educational and Learning Processes, Parts 1 and/or 2 (option)/ Phase I: Session 4
A.M.	Defining Expectations of Community Technology Training Program/ Phase I: Session 2	Assessing Community Water Needs and Uses/ Phase IV: Session 3	Development of Facilitation Skills Criteria (option)/ Phase I: Session 5
	Group Resource Assessment/ Phase I: Session 3		Introduction to Solar Water Heating: Determining Hot Water Demand/ Phase IV: Session 4
P.M.	Hollow Square/ Phase I: Session 7	Global Energy Issues/ Phase I: Session 14	Environmental Health and Sanitation/ Phase II: Session 1

	DAY 4	DAY 5	DAY 6
	Plumbing a Solar Water Heater/ Phase IV: Session 5	The Role of the Volunteer in Development: The Definition of Appropriate Technology/ Phase II: Session 13	Use of Appropriate Aids to Communication/ Phase III: Session 6
A.M.	Sizing a Solar Water Heater/ Phase IV: Session 6	Insolation Meter Construction/ Phase II: Session 9	Demonstration of a Technical Concept/ Phase IV: Session 7
	Appropriate Technologies for Health/ Phase III: Session 13	The Path of the Sun/ Phase III: Session 2	
P.M.	Introduction to Independent Study/ Phase II: Session 6	Case Studies in Community Health/ Phase III: Session 14	

	DAY 7	DAY 8	DAY 9
A.M.	Heat Transfer/ Phase III: Session 16 Shade Mapping and Solar Siting/ Phase IV: Session 8	Construction of Solar Water Heaters/ Phase IV: Session 10	Volunteer in Development: Part 1: Women in Development/ Phase III: Session 19 Construction of Solar Water Heaters (continued) / Phase IV: Session 10
P.M.	Design of Solar Water Heaters/ Phase IV: Session 9		

	DAY 10	DAY 11	DAY 12
A.M.	Issues and Methods in the Development and Diffusion of Appropriate Technology/ Phase V: Session 11	Construction of Solar Water Heaters (continued)/ Phase IV: Session 10 Independent Study	Independent Study and Clean-Up Evaluation and Integration of Training Themes, Parts 1, 2 and 3/ Phase I: Session 16
P.M.	Construction of Solar Water Heaters (continued) / Phase IV: Session 10	Presentation of Solar Water Heaters/ Phase IV: Session 15	

SOLAR AGRICULTURAL DRYERS (Week One) TWO-WEEK WORKSHOP - Page 1

	DAY 1	DAY 2	DAY 3
A.M.	Sharing Perceptions of Appropriate Technology: An Ice Breaker/ Phase I: Session 1	Introduction to Agricultural Dryers/ Phase V: Session 1	Global Energy Issues/ Phase I: Session 14
	Defining Expectations of Community Technology Training Program/ Phase I: Session 2	Tour of Solar Dryers/ Phase V: Session 2	Solar Agricultural Dryer Procedures and Rules of Thumb/ Phase V: Session 3
P.M.	Group Resource Assessment/ Phase I: Session 3	Appropriate Educational and Learning Processes, Parts 1 and/or 2 (option)/ Phase I: Session 4	Two-Hour Dryer Construction/ Phase V: Session 4
	Hollow Square/ Phase I: Session 7	Development of Facilitation Skills Criteria/ Phase I: Session 5	Review of Existing Solar Dryer Plans/ Phase V: Session 5

	DAY 4	DAY 5	DAY 6
A.M.	Maternal and Child Health, Part 1/ Phase III: Session 1	Smoke Testing Solar Dryers/ Phase V: Session 6	The Role of the Volunteer in Development: The Definition of Appropriate Technology Phase II: Session 13
		New Technologies: Introducing Solar Dryers/ Phase V: Session 7	
	Insolation Meter Construction/ Phase II: Session 9	Design of Solar Agricultural Dryers/ Phase V: Session 8	Introduction to Independent Study/ Phase II: Session 6
	The Path of the Sun/ Phase III: Session 2		
P.M.	Heat Transfer/ Phase III: Session 16		

	DAY 7	DAY 8	DAY 9
A.M.	Site Selection and Preparation/ Phase V: Session 9	Basic Nutrition/ Phase II: Session 23	Volunteer in Development: Part 1, Women in Development/ Phase III: Session 19
	Construction of Solar Agricultural Dryers/ Phase V: Session 10	Construction of Solar Agricultural Dryers (continued)/ Phase V: Session 10	Construction of Solar Agricultural Dryers (continued)/ Phase V: Session 10
P.M.			Practical Drying Tips/ Phase V: Session 15 Independent Study

	DAY 10	DAY 11	DAY 12
A.M.	Nutritional Gardening/ Phase V: Session 14	Issues and Methods in the Development and Diffusion of Appropriate Technology/ Phase V: Session 11	Presentation of Solar Dryers/ Phase V: Session 19 Evaluation and Integration of Training Themes, Parts 1, 2 and 3/ Phase I: Session 16
P.M.	Dryer Assessment and Modification/ Phase V: Session 17	Introduction to Cost Benefit Analysis/ Phase V: Session 18 Use of Appropriate Aids to Communication/ Phase III: Session 6 Independent Study	

APPENDIX C: BIBLIOGRAPHIES

KEY

** Distribute to Trainees.
Denotes texts that should be purchased in sufficient quantities for distribution to all trainees.

* Necessary for Trainers.
Indicates essential resources that should be on hand as reference for trainers and/or for photocopying of selected parts for distribution to participants.

No asterisk indicates those publications which are recommended but not essential to carry out the program.

KEY:

** Distributed to Trainees
* Necessary for Trainers
Effective, if available

EARTHEN CONSTRUCTION AND FUEL-SAVING COOKSTOVES

* Aprovecho Institute. Cookstove News, a quarterly. 442 Monroe Street, Eugene, Oregon 97402.

* _____. Guidelines on Evaluating the Fuel Consumption of Improved Cookstoves. Manual for USAID. Aprovecho Institute, 442 Monroe Street, Eugene, Oregon 97402. 1981.

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* Eckholm, Eric P. Losing Ground. New York: W. W. Norton Co., Inc., 1976.

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* Farallones/Aprovecho Institutes. Traditional and Improved Cookstoves from Around the World. A slide show presentation, 1981.

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ALTERNATIVE COOKSTOVES: PRESENTATIONS

Total time: 1 hour

Objectives:
* To discuss experiences gained during stove construction
* To compare and contrast the construction of the second group of cookstoves with the first
* To discuss alternatives to sheetmetal stove pipes
* To discuss chimney safety

Resources: Evans and Boutette, Lorena Stoves, pp. 66-68, 72, 108

Materials: Recently completed cookstoves, old stovepipe with creosote buildup

Trainer Notes

Before beginning this session, list the discussion questions on newsprint (or make copies for distribution). See Step 2.

Procedures:

Step 1. (5 minutes)
Introduce the session objectives and activities.

Step 2. (45 minutes)
Have each group present and explain their newly completed cookstoves.

Trainer Notes

Have the groups present and discuss their stoves, answering the following questions:

* What criteria were used when designing the stove?
* What was learned during the construction of the cookstove?
* What would you do differently next time?
* If your stove has a chimney, what sort of chimney was built and why? Were alternative materials used?
* How did your second stove construction activity compare with the first?
* What different approaches to problem-solving were used?

Encourage questions and discussion from the group at the end of each presentation.

Step 3. (10 minutes)
Discuss chimney safety.

Trainer Notes

* Have a piece of old stovepipe with a heavy creosote buildup to circulate among the participants.

* Ask the participants to explain how and why creosote buildup occurs and why it is dangerous.

* Discuss briefly the maintenance, safety and insulation of chimney pipes.

* Examine the advantages of alternative stovepipe materials for insulation and minimizing creosote buildup.

* Refer the participants to Lorena Stoves, pages 67, 72 and 108 for further information.

BASIC NUTRITION

Total time: 2 hours

Objectives:
* To discuss and examine basic nutritional needs
* To discuss and analyze personal eating habits
* To discuss methods for nutrition education

Resources:
* Jelliffe, Child Nutrition in Developing Countries, Chapter 2
* King, Nutrition in Developing Countries
* Werner, Where There Is No Doctor, pp. 107-130
* Attachment II-23-A, "Signs of Nutritional Status"
* Attachment II-23-B, "The Food Square"
* Attachment II-23-C, "Plant Protein Complimentarity"
* Attachment II-23-D, "Daily Dietary Guidelines"
* Attachment II-23-E, "Four Day Food Diary"
* Attachment II-23-F, "Nutrition Education Tools"

Materials: Newsprint and felt-tip pens, "Favorite Food Lists" (developed by participants in Phase II: Session 20)

Trainer Notes

Copy Chapter 2, "The Human Diet," from Jelliffe's Child Nutrition in Developing Countries to distribute to participants as background reading material.

Procedures:

Step 1. (30 minutes)
Distribute the Jelliffe article, "The Human Diet," and Attachment II-23-A, "Signs of Nutritional Status," and allow time for people to read them.

Step 2. (10 minutes)
Distribute and review Attachments II-23-B, "The ood Square," and II-23-C, "Plant Protein Complimentarity."

Step 3. (15 minutes)
Have the participants form pairs. Using the lists developed in Session 20 of favorite foods, have them identify where the foods fit on the food square.

Step 4. (10 minutes)
Reconvene the participants and have them discuss their findings.

Trainer Notes

The following questions will help focus the discussion:

* What nutrients appear most in your favorite foods? Least?
* Are your food preferences beneficial, harmless or harmful to your health?
* Have your food preferences changed in nutritional value since childhood?

Step 5. (10 minutes)
Distribute and review Attachment II-23-D, "Daily Dietary Guidelines."

Trainer Notes

Point out that these guidelines offer one simple approach to determine the quality of daily diet.

Step 6. (20 minutes)
Have the group form pairs to conduct 24-hour dietary recalls on one another.

Trainer Notes

Explain the recall practice as a way to spot-check the adequacy of the daily diet. The food square and daily dietary guidelines should be consulted to evaluate the day's diet.

Step 7. (15 minutes)
Review the session objectives and distribute Attachment II-23-E, "Four Day Food Diary," as an assignment.

Trainer Notes

Explain that the assignment should be done over a four-day period and should serve to familiarize participants with how well daily diets meet established dietary guidelines. Answer any questions about the activity. Collect the diaries when they are completed and be available to offer help whenever necessary.

Step 8. (15 minutes)
Have the group discuss some ideas on nutrition education and distribute Attachment II-23-F for review.

Trainer Notes

The following questions will stimulate discussion:

* What do you think motivates people to improve their diets?
* Have you learned anything in this session that might lead you to improve your diet?
* Do you think some of the suggested concepts and tools can be applied successfully in your work as Peace Corps Volunteers?
* How do you plan to learn about local community foods and diets?
* Can you begin to think of ways appropriate technologies and nutrition can be used together?

Then, cite Jelliffe, King and Werner and Bower in the bibliography as resources for nutrition education.

UNDERSTANDING THE COOKSTOVE DESIGN PROCESS AND SOIL MIXES

Total time: 1 hour, 30 minutes

Objectives:

* To design a fuel-saving cookstove
* To discuss the importance of user input in the design process
* To discuss the principles of sand/clay ("Lorena") mixes

Resources: Evans and Boutette, Lorena Stoves, pp. 28-50

Materials: Pots, pans, lids, sand, clay, containers of different soil types, screens (filters), buckets, shovels, hoes, and water

Trainer Notes

This session requires preparation. Step 2 asks for three separate trainers to run through the three suggested roles. These trainers should be familiar with the particular stove design on which their roles will be focusing (See Trainer Notes under Step 2 for more specific information on the role-playing procedure).

Procedures:

Step 1. (5 minutes)
Review the session objectives and activities.

Step 2. (45 minutes)
Ask the participants to form three work groups. Introduce the three trainers who are playing the role of "villagers." Explain that each group should join one of the "villagers" to assist in assessing his/her needs regarding stove design.

Trainer Notes

Three types of cookstoves are suggested as the basis for the role playing: the Lorena, the Louga and the Java Chimneyless (See pages 28-38 of Lorena Stoves). These stoves were selected because they originated in three different parts of the world and their designs incorporate specific cultural and environmental needs.

Continued

Trainer Notes/Continued

Each of the three trainers to be involved in the role playing should be thoroughly versed with one of these cookstoves and their cultural/environmental origins. Each trainer should be prepared to play the role of a villager from the country of origin of his/her cookstove. For example, the trainer responsible for the Lorena Stove would play a highland Guatemalan villager, reflecting that particular stove's origin.

Each "villager" should have pots and pans of the type and size used to design the particular stove and any other props that could add to the authenticity of the role-playing situation (i.e., dressing as a Guatemalan villager).

The idea is for the "villager" to manifest needs that will lead the work groups to discover the particular design suited to those needs (for instance, the Lorena for the Guatemalan highlander). The villager should try not to "give away" the stove design and allow the work groups to experience designing the stove with the villager's participation. It may be necessary for the trainer to occasionally step out of the role of the villager to help explain certain technical points during the conversation. This design process should involve drawing the stove layout on the ground and arranging the pots according to the design principles discussed in the previous session and on pages 28-50 of Lorena Stoves.

Explain that each of the work groups will continue the process by actually building and using the stove they and the "villager" have designed.

Step 3. (20 minutes)
Reconvene the work groups and discuss soils and soil mixes.

Trainer Notes

The following questions may help stimulate discussion:

* What do you remember about soils from the earthen block session?
* What are the three components of soil?
* What distinguishes one type of soil from another?
* What are the characteristics of clay, sand and silt? How do they feel?
* How and where would you find clay? Sand?

Have containers of different soil types available to circulate so that people can feel and see the difference.

Continued

Trainer Notes/Continued

Conduct the soil tests for clay, if they haven't already been completed in the session on earthen blocks (see pages 42-44 of <u>Lorena Stoves</u> for details).

Distinguishing between usable and unusable clays is important. Make and fire clay balls to demonstrate that good clay holds together and poor clay flakes apart.

If time permits, conduct a field-walk to clay and sand deposits.

Step 4. (20 minutes)
Facilitate a discussion on clay/sand ("Lorena") mixes.

Trainer Notes

Guide the discussion with the following questions:

* What roles do sand and clay play in a mix?
* How would you test for a good sand/clay mix?

Have sample clay/sand mixtures of different proportions available so that participants can see and feel the differences. It is helpful to have dried test blocks available.

Refer the participants to pages 47-49 of Lorena Stoves and discuss the different tests for determining the suitability of the sand/clay mixtures for stove construction. These tests are: test blocks (make some to test later), the palm, ball tests (do during the session) and model stoves.

Mention that there will be ample opportunities during the following construction sessions to develop a feel for the correct mix of sand and clay.

Trainer Notes/Continued

Each of the three trainers to be involved in the role playing should be thoroughly versed with one of these cookstoves and their cultural/environmental origins. Each trainer should be prepared to play the role of a villager from the country of origin of his/her cookstove. For example, the trainer responsible for the Lorena Stove would play a highland Guatemalan villager, reflecting that particular stove's origin.

Each "villager" should have pots and pans of the type and size used to design the particular stove and any other props that could add to the authenticity of the role-playing situation (i.e., dressing as a Guatemalan villager).

The idea is for the "villager" to manifest needs that will lead the work groups to discover the particular design suited to those needs (for instance, the Lorena for the Guatemalan highlander). The villager should try not to "give away" the stove design and allow the work groups to experience designing the stove with the villager's participation. It may be necessary for the trainer to occasionally step out of the role of the villager to help explain certain technical points during the conversation. This design process should involve drawing the stove layout on the ground and arranging the pots according to the design principles discussed in the previous session and on pages 28-50 of <u>Lorena Stoves</u>.

Explain that each of the work groups will continue the process by actually building and using the stove they and the "villager" have designed.

Step 3. (20 minutes)
Reconvene the work groups and discuss soils and soil mixes.

Trainer Notes

The following questions may help stimulate discussion:

* What do you remember about soils from the earthen block session?
* What are the three components of soil?
* What distinguishes one type of soil from another?
* What are the characteristics of clay, sand and silt? How do they feel?
* How and where would you find clay? Sand?

Have containers of different soil types available to circulate so that people can feel and see the difference.

Continued

Trainer Notes/Continued

Conduct the soil tests for clay, if they haven't already been completed in the session on earthen blocks (see pages 42-44 of Lorena Stoves for details).

Distinguishing between usable and unusable clays is important. Make and fire clay balls to demonstrate that good clay holds together and poor clay flakes apart.

If time permits, conduct a field-walk to clay and sand deposits.

Step 4. (20 minutes)
Facilitate a discussion on clay/sand ("Lorena") mixes.

Trainer Notes

Guide the discussion with the following questions:

* What roles do sand and clay play in a mix?
* How would you test for a good sand/clay mix?

Have sample clay/sand mixtures of different proportions available so that participants can see and feel the differences. It is helpful to have dried test blocks available.

Refer the participants to pages 47-49 of Lorena Stoves and discuss the different tests for determining the suitability of the sand/clay mixtures for stove construction. These tests are: test blocks (make some to test later), the palm, ball tests (do during the session) and model stoves.

Mention that there will be ample opportunities during the following construction sessions to develop a feel for the correct mix of sand and clay.

Trainer Notes/Continued

Each of the three trainers to be involved in the role playing should be thoroughly versed with one of these cookstoves and their cultural/environmental origins. Each trainer should be prepared to play the role of a villager from the country of origin of his/her cookstove. For example, the trainer responsible for the Lorena Stove would play a highland Guatemalan villager, reflecting that particular stove's origin.

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Continued

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Mention that there will be ample opportunities during the following construction sessions to develop a feel for the correct mix of sand and clay.

GUIDELINES FOR PLANNING THE ENERGY FAIR

* All participants should participate fully in the preparation and demonstration of devices and be responsible for food, fuel, water supplies and any other necessary materials.

* Throughout the activities of the Fair, there should be an emphasis on the integration of the themes presented during training, including implications for:

    1. Health
    2. Participation of all community members
    3. Concepts of adult learning
    4. Global energy and development issues
    5. Technical information transfer
    6. Appropriate communication and extension skills

* Information should be available to all guests and community members.

* Music, games and food should be an integral part of the Fair.

* A schedule of events should be developed and made available to all participants and guests.

* The role of the training staff will be to provide guidance and advice. The program participants should have the opportunity to be responsible for all aspects of the Fair.

* The first three days of the final phase will be provided for planning and preparation. During this time, final evaluations and interviews will also occur.

* One of the major objectives of the Energy Fair is to provide an opportunity to competently use and demonstrate devices built during the training program while focusing on the use of appropriate facilitation skills and methods of communication.

DEMONSTRATION GUIDELINES *

Purpose

It is very important that you have clearly in your mind the exact purpose of your demonstration. If your purpose is not clear to you, you will not be able to communicate it clearly to someone else.

The first thing you must consider in giving a demonstration is your audience. The following is a list of questions which should be considered when planning a demonstration.

1. How large is your audience?
2. Is there an optimum size?
3. What is the audience interest?
4. What is the audience age?
5. What is the audience's level of education?
6. How much does the audience know about the subject?

Key points:

7. If the subject of demonstration is new to the audience, can it be related to some experience or subject common to all?
8. Does implementing demonstration techniques involve financial or emotional risk to members of the audience?

Planning

Secondly, you should plan the procedure step by step to eliminate confusion, keep things moving smoothly, ensure correct results and, most important of all, <u>know your subject matter</u>.

1. You should limit the scope of the demonstration, so that it covers only one subject, can be covered well and is not so long as to lose the attention of the audience.

2. If the demonstration is part of a series of demonstrations necessary to convey a complete idea, try to include a minimum of material connecting it to succeeding demonstrations.

3. Be sure you have all the materials and implements necessary to do the demonstration. Do not rely on people to bring a necessary implement or material when they come to the demonstration. Have it ready beforehand.

4. Will the villager have all the tools and materials necessary to implement what you have demonstrated? If not, can you help to obtain them?

5. Be sure you can handle the tools necessary for the demonstration sufficiently well to be credible.

6. How much work is needed to adequately demonstrate the process?

* From CHP/Guatemala

7. Know all technical terms necessary for the demonstration.

8. If the demonstration is new to you, do it by yourself once to be sure of steps, problems, etc.

9. Think about ways to reinforce learning (i.e., will it be necessary to work with each person who attended the demonstration on an individual basis? A repeat demonstration?

10. Think of ways to get people to come (for example, send word with school children, individual home visits, community notice).

11. You may want to keep a list of persons who attended the demonstration to help you remember who will need a follow-up visit and, if you are giving a series of demonstrations, to know who missed which demonstration.

Visual Aids

Visual aids can play an important part in a demonstration. A visual aid need not be a drawing. It can be a model, a finished product, a picture or a photo. Any visual aid used should be an integral part of the demonstration and not something which will be distracting in itself. The following are some questions to be considered when developing visual aids for a demonstration (since the meaning of "visual aids" may differ from what you intend or to what villagers understand in their culture):

1. Does the demonstration require visual aids?
2. Can something else be used more effectively?
3. Do the aids need to be drawn?
4. Should they be drawn before or during the demonstration?
5. Is the audience acquainted with visual aids?
6. Is it simple enough to be understood?
7. Are you sure your picture conveys the message you intend in a cross-cultural situation?

Demonstration

If the demonstration has been carefully planned, the actual demonstration should go well.

1. Begin with a simple introduction, thanking the people for coming, particularly any community leader(s) present.

2. You may want to start the demonstration by getting the audience into a directed discussion which will lead to the realization of the need for or usefulness of that project, method or process which you are about to demonstrate. Or, if the underlying need or purpose is understood, a simple statement of the object of the demonstration should be given.

3. Explain preliminary layout of materials, tools, etc.

4. Work through steps according to your plan, explaining each step as you go. This is particularly important when the steps have a specific order.

5. Have visual aids at hand so there will be no interruption while going to get them or taking the audience to a room to use the blackboard.

6. Ask if there are any questions after each step.

7. When you are finished, summarize the procedure.

8. Offer to help those willing to try what you have demonstrated. Set a specific date for individual help if the person shows sufficient interest.

9. Thank the people again for attending the demonstration.

A good demonstration consists of a well-defined purpose and a well-thought-out plan, taking into consideration the audience needs, interests, abilities and age. Careful use of visual aids can make the conveying of an idea much easier and clearer and a good plan makes things run more smoothly.

PHASE VI: CONCLUDING THE PROGRAM: THE ENERGY FAIR

The Energy Fair

The Role of the Volunteer in Development

Training Program Evaluation

PHASE VI CALENDAR - PAGE 1

	DAY 1	DAY 2	DAY 3
A.M.	SESSION 1: Orientation to Final Assessment and Evaluation (Skill Areas II & V) SESSION 2: Preparation for the Energy Fair (I & IV)	Preparation (continued)	Preparation (continued)
P.M.	Preparation (continued)	Preparation (continued)	Preparation (continued)

	DAY 4	DAY 5	DAY 6
A.M.	SESSION 3: The Energy Fair (IV)	Clean-up SESSION 5: Energy Fair Evaluation (V)	Final Preparations for Departure
P.M.	SESSION 4: Final Clean-up and Project Disassembly (IV)	SESSION 6 Training Program Evaluation (V) SESSION 7: Resources (III)	

ORIENTATION TO FINAL ASSESSMENT AND EVALUATION

Total time: 2 hours

Objectives:

* To discuss and clarify the final assessment and evaluation process
* To develop a written, cumulative self-assessment/evaluation
* To discuss and develop a final written recommendation regarding invitations to continue Peace Corps service

Resources:

* Attachment VI-1-A, "Final Assessment Worksheet"
* Attachment VI-1-B, "Final Assessment Implementation Plan"
* Copies of the five "Trainer Evaluation Forms" and "Self-Evaluation Sheets" used during the counterpart sessions throughout the training program

Procedures:

Step 1. (5 minutes)
Begin by reviewing the objectives and explaining the goals of the final assessment/evaluation process.

Trainer Notes

The goal of the final assessment/evaluation process is to produce a written, final recommendation which will provide both participant and Peace Corps with a cumulative assessment of skill levels as well as a mutually-negotiated decision regarding suitability to continue with in-country training.

Step 2. (10 minutes)
Distribute and explain Attachment VI-1-A, "Final Assessment Worksheet," and Attachment VI-1-B, "Final Assessment Implementation Plan." Allow time for discussion and questions.

Trainer Notes

An individual worksheet should be provided for each of the four major skill areas to be evaluated (communication skills, commitment to program, technical skills and cognitive skills).

Step 3. (10 minutes)
Provide a brief explanation of the time-line of the final assessment process.

Trainer Notes

Due to the nature of the final phase of the training program, the time-line for carrying out the final assessment process should remain flexible and responsive to the needs of both participants and staff as dictated by commitments arising from preparation for the Energy Fair. You may find it helpful, however, to suggest that all final interviews be completed no later than the fourth day of the final phase. This will allow ample time for processing final recommendations prior to the departure of the participants.

Step 4. (5 minutes)
Give each participant a copy of each of the five past "Trainer Evaluation Forms" and "Self-Evaluation Sheets" explaining that they should be used as reference aids in writing the cumulative, self-assessment/evaluation.

Trainer Notes

In completing the worksheets, you may wish to ask participants to focus on providing succinct, cumulative statements of their self-assessments and to identify specific skill areas that they would like to continue to develop during training.

Step 5. (85 minutes)
Have the participants complete their written, cumulative statements.

Step 6. (5 minutes)
Collect the completed worksheets and all copies of the "Trainer Evaluation Forms" and "Self-Evaluation Sheets."

Trainer Notes

In keeping with the Final Assessment Implementation Plan (See Attachment VI-1-B), worksheets, "Trainer Evaluation Forms" and "Self-Evaluation Sheets" should be made available to the training staff for the purpose of developing the cumulative assessment of each participant.

Based on these two written perspectives (participant and training staff), the final interview should be a dialogue between participant and staff in which final, cumulative assessment statements and the resultant recommendations for invitation to Peace Corps service are negotiated mutually and entered in writing in the column of the worksheets.

Continued

Trainer Notes

These final, cumulative statements should be typed according to the format provided below and distributed to participants for signing.

Copies of the final recommendations should be made available to participants, the training institute and to appropriate Peace Corps authorities.

Following is a suggested format for the final written evaluations/recommendations:

FINAL EVALUATION/RECOMMENDATION

(Participant Data)

Name: ______________________

Program #: ________________

(Training Institute Data)

Name: __________________

Address: _______________

I. SKILL AREAS

A. Communication Skills
(Cumulative statement from "Final Assessment Worksheet")

B. Commitment to Program
(Cumulative statement from "Final Assessment Worksheet")

C. Technical Skills
(Cumulative statement from "Final Assessment Worksheet")

D. Cognitive Skills
(Cumulative statement from "Final Assessment Worksheet")

II. FINAL RECOMMENDATION

In view of the above evaluation, the (name of training institute) and (name of participant) mutually recommend that an invitation to further in-country training should/should not be extended at this time.

Signature of
Participant: _______________________ Date: ___________________

FINAL ASSESSMENT WORKSHEET

Name: Program #:

* For the major skill area listed below, provide a cumulative assessment of skill level.
* Include reference to any specific skill areas upon which further training should focus.
* Provide a final recommendation regarding continued Peace Corps service.

Skill Area	Participant Cumulative Assessment	Training Staff Cumulative Assessment	Final Cumulative Statement
Final Recommendation			

FINAL ASSESSMENT IMPLEMENTATION PLAN

I. In writing, on "Final Assessment Worksheets" --

   A. Participants develop a self-assessment of their skill levels in each of the four major skill areas, based on their comments on the "Self-Evaluation Sheets."

   B. The training staff develops a similar assessment, based on their comments on the "Trainer Evaluation Forms."

II. During final interviews --

   A. Participants and training staff discuss their respective assessment statements on the worksheets.

   B. Participants and training staff negotiate final, mutually-acceptable, written statements which:

      1. Represent a summary of participant's skill levels in each of the four major skill areas

      2. Identify any specific skill areas which the participant may need additional opportunity to develop

      3. Provide a statement of final recommendation regarding the participant's suitability to continue Peace Corps service.

III. Final, cumulative statements are typed according to a "Final Evaluation/Recommendation" format and distributed to participants for signing.

IV. Copies of the "Final Evaluations/Recommendations" are made available to participants, the training staff, Peace Corps in-country representatives and Peace Corps Washington representatives.

PREPARATION FOR THE ENERGY FAIR

Total time: 22 hours

Objective: To plan and prepare the presentation of a community festival

Resources: As determined by the participants

Materials: As determined by the participants

Procedures: As determined by the participants

Trainer Notes

In keeping with the overall goal of providing participants with the opportunity to creatively demonstrate and practice skills acquired during the training program, you should encourage them to work as independently of the training staff as possible in all aspects of planning and coordinating the Energy Fair activities.

The training staff should be available for the purpose of providing consultation and guidance only.

THE ENERGY FAIR

Total time: 4 - 6 hours

Objectives:
* To present a community festival
* To demonstrate communication, cognitive and technical skills acquired during the training program

Resources: As determined by the participants

Materials: As determined by the participants

Procedures: As determined by the participants

Trainer Notes

In keeping with the overall goal of providing participants with the opportunity to creatively demonstrate and practice skills acquired during the training program, you should encourage them to work as independently of the training staff as possible in all aspects of implementing Energy Fair activities.

The training staff should be available for the purposes of providing consultation and guidance only.

If videotape equipment is available, you should arrange to record the Energy Fair activities for the purpose of providing a basis for up-coming Energy Fair evaluation (See Phase VI: Session 5).

FINAL CLEAN-UP AND PROJECT DISASSEMBLY

Total time: 4 hours

Objectives:

* To clean and organize the training site
* To disassemble and/or store devices built during the training program

Resources: As needed

Materials: As needed

Procedures: As needed

Trainer Notes

* Following the Energy Fair, it is expected that there will be a need for cleaning up the training site, dismantling or storing devices and removing any additional equipment built for use in the Fair.
* The procedures for this activity will depend upon the nature of the Energy Fair and, therefore, should be determined by the participants.
* One or two members of the training staff should be available to provide assistance.

ENERGY FAIR EVALUATION

Total time: 2 hours

Objectives:

* To evaluate the planning and implementing of the Energy Fair
* To plan, carry out and evaluate a training session

Materials: Newsprint and felt-tip pens

Trainer Notes

> You may wish to select a participant to facilitate this session. If so, be certain to brief the participant in advance. Also, allow time at the end of the session for feedback on the participant's facilitation skills.

Procedures:

Step 1. (5 minutes)
Review the session objectives and procedures.

Trainer Notes

> This session is designed to carry out two processes at the same time: the participants themselves will be called upon to determine the procedure and will be practicing the skills involved in session planning while simultaneously evaluating the Energy Fair.

Step 2. (10 minutes)
Have the participants brainstorm a list of 4 or 5 criteria for evaluating their work in planning and implementing the Energy Fair. Post their responses on newsprint.

Trainer Notes

> * This step should be kept as brief as possible since the criteria are meant to serve only as a basis for generating discussion.
>
> * Provide some focus by suggesting such broad areas for evaluation as the effectiveness of planning, group work, facilitation skills, demonstrations, etc.

Step 3. (10 minutes)
Assist the participants in identifying a procedure for evaluating the Energy Fair using the criteria they have established.

Trainer Notes

* Assist the participants by suggesting the importance of outlining the procedure in a step-by-step manner and setting time limits based on the time allotted for Step 4.

* If a video recording of the Energy Fair has been made, suggest including it in the evaluation procedure.

Step 4. (90 minutes)
Have the participants carry out the planned procedures.

Step 5. (5 minutes)
Conclude the session by soliciting feedback from the participants regarding how well the objectives were met.

Trainer Notes

The focus of this feedback should be on the group's effectiveness at evaluating the Energy Fair as well as on their effectiveness at planning and implementing this session.

TRAINING PROGRAM EVALUATION

Total time: 2 hours

Objectives:
* To evaluate, both verbally and in writing, the overall effectiveness of the training program
* To plan, carry out and evaluate a training session

Resources: Attachment VI-6-A, "Mid-Cycle and Final Evaluation of Training Goals"

Materials: Newsprint and felt-tip pens

Trainer Notes

> Ask a participant volunteer to facilitate this session. Be certain to brief him/her thoroughly in advance and allow time at the end of the session for feedback on the facilitation skills demonstrated.

Step 1. (5 minutes)
Review the session objectives and explain that the purpose of this evaluation is to provide feedback on the training program which will be used in planning future training programs.

Trainer Notes

> This session is designed to carry out two processes at the same time: the participants will be called upon to determine the procedures and will be practicing skills involved in session planning while simultaneously evaluating the training program.

Step 2. (10 minutes)
Distribute and briefly explain Attachment VI-6-A, "Mid-Cycle and Final Evaluation of the Training Goals."

Trainer Notes

> Explain that the evaluation form is intended only as a guide in helping participants develop their own plan for evaluating the training program.

Step 3. (15 minutes)
Assist participants in planning a procedure for evaluating both verbally and in writing the overall effectiveness of the program.

Trainer Notes

Mention the importance of outlining the procedure in a step-by-step manner and setting time limits based on the time allotted for Step 4.

Step 4. (80 minutes)
Have the participants carry out the planned procedures.

Step 5. (10 minutes)
Collect the written evaluations and conclude the session, soliciting feedback regarding how well the objectives were met.

Trainer Notes

This feedback should focus on the group's effectiveness at evaluating the program as well as on the group's effectiveness at planning and implementing the session.

MID-CYCLE AND FINAL EVALUATION OF TRAINING GOALS

Rate the effectiveness of the training program in achieving the following goals. Give 2 or 3 specific examples in support of your rating.

	Not very Effective		Adequate		Extremely Effective
1. Assess and analyze community felt needs	1	2	3.	4	5
2. Assist others in the design, adaptation, construction, utilization and maintenance of simple technologies	1	2	3	4	5
3. Acquire and apply skills and attitudes that promote the improvement of the quality of life through local initiative, community problem solving	1	2	3	4	5
4. Examine and understand the cultural and societal values that accompany all overseas development workers	1	2	3	4	5
5. Develop and practice effective experiential learning and teaching processes	1	2	3	4	5
6. Understand the synergistic relationship between health and technology and the interrelated nature of all aspects of culture	1	2	3	4	5
7. Encourage and include the active, full participation of all community members in programs of change	1	2	3	4	5
8. Maintain personal well-being and the attitudes conducive to effective and appropriate overseas service	1	2	3	4	5

RESOURCES

Total time: 1-1/2 hours

Objective: To identify and discuss resources available to assist field workers in developing countries

Resources:

* Attachment VI-7-A, "Appropriate Technology Information and Resource List"
* Bibliography, from Training Manual

Materials: Paper and pens

Procedures: Step 1. (10 minutes)
Review the session objectives and distribute Attachment VI-7-A, "Appropriate Technology Information and Resource List," and the Bibliography from Appendix C.

Trainer Notes

While distributing the materials, explain that an important role of community development facilitators is to promote the exchange and development of resource information.

Step 2. (30 minutes)
Facilitate a discussion of some of the various resources available to Peace Corps Volunteers and of appropriate ways to use them.

Trainer Notes

Some suggested topics for this discussion include:

Host country resources:

* Government agencies, offices and ministries
* Libraries
* Embassies (for literature and films)
* Other voluntary agencies and assistance groups
* Other PCVs and staff
* Development agencies (UNDP, USAID)

Peace Corps, Washington:

* Information Collection and Exchange (ICE)
* ACTION library
* Desk officers

Continued

Trainer Notes/Continued

Organizations that provide technical assistance, including:

* Volunteers in Technical Assistance
* Intermediate Technology Development Group
* League for International Food Education

Films and periodicals:

* See resource lists.

Health and nutrition information:

* See resource lists.

Women in development information:

* See resource lists.

Funding:

* Peace Corps Partnership Program
* US AID
* Local resources
* Private voluntary organizations
* VITA
* Appropriate Technology International
* International development groups and appropriate technology organizations
* Review of proposal writing

Networking:

* Development and appropriate technology organizations
* Newsletters and journals
* Establishment and maintenance of a Peace Corps Energy Program network

Step 3. (25 minutes)
Encourage participants to contribute additional resource information and exchange any addresses which may be mutually beneficial.

Step 4. (15 minutes)
Conclude the session by encouraging a brief discussion of ways in which participants can provide one another with informational support while in the field.

Trainer Notes

Suggest newsletters, correspondence, tapes, etc. and emphasize the importance of forming and joining a network of development facilitators who share similar goals.

APPROPRIATE TECHNOLOGY INFORMATION AND RESOURCE LIST

Information Collection & Exchange
Office of Multilateral and Special Programs
ACTION/Peace Corps
806 Connecticut Ave. N. W.
Washington, D. C. 20525
(for program and training journals, and appropriate technology information)

Farallones Institute Rural Center
15290 Coleman Valley Road
Occidental, CA 95465

Farallones Institute Urban House
1516 5th Street
Berkeley, CA 94710
(plans, drawings, publications, info)

Aprovecho Institute
359 Polk Street
Eugene, OR 97402
503-929-6925

Community Environmental Council
924 Anacapa St., Suite B4
Santa Barbara, CA 93101
(drawings, publications, info)

Institute for Local Self-Reliance
1717 18th St. N. W.
Washington, D.C. 20009
(charts, drawings, publications, info)

State of California Office of Appropriate Technology
1623 10th St.
Sacramento, CA 95814
916-445-1803

New Alchemy Institute
Box 432
Woods Hole, MA 02543
(info and monthly journal)

Appropriate Technology International
1709 N St. N. W.
Washington, D.C. 20036
202-293-9270
(funding & info for 3rd world groups)

Hesperian Foundation
P. O. Box 1692
Palo Alto, CA 94302
415-327-4576
(health & self-help info)

INFORMATION WITH PUBLICATIONS

Newsletters and books

Volunteers in Technical Assistance
3706 Rhode Island Ave.
Mt. Rainier, MD 20822
(monthly newsletter, technical assistance service & Vita Village Technology Handbook in Spanish and English)

Appropriate Technology Project
Volunteers in Asia
Box 4543
Stanford, CA 94305
(excellent Appropriate Technology Sourcebook to get you to what you are looking for)

Intermediate Technology Development Group
9 King St.
London WCQE 8HN
England
(quarterly Journal of Appropriate Technology - if you only have one to subscribe to, this is it! and publications list on everything you can imagine)

International Association for the Advancement of Appropriate Technologies for Developing Countries
University of Michigan
603 East Madison
Ann Arbor, MI 48109
313-764-6410
(monthly journal called Approtech)

Continued

Transnational Network for Appropriate
Technologies (TRANET)
P. O. Box 567
Rangeley, ME 04970
(excellent networking and ideas-oriented newsletter)

Vecinos Mundiales/World Neighbors
5116 North Porland Avenue
Oklahoma City, OK 73112
(quarterly magazine in both Spanish & English; excellent for material on work you might do in community development)

Brace Research Institute
McDonald College of McGill University
Ste. Anne de Bellevue, P. Q.
HOA ICO Canada
(lots of technical information)

Canadian Hunger Foundation
75 Sparks St.
Ottawa, Ontario
KIP 5A5 Canada
(last two groups have jointly published <u>A Handbook in Appropriate Technology</u>)

Technical Assistance Information Clearinghouse
(TAICH)
200 Park Ave. South
New York, NW 10002
(newsletter on world issues)

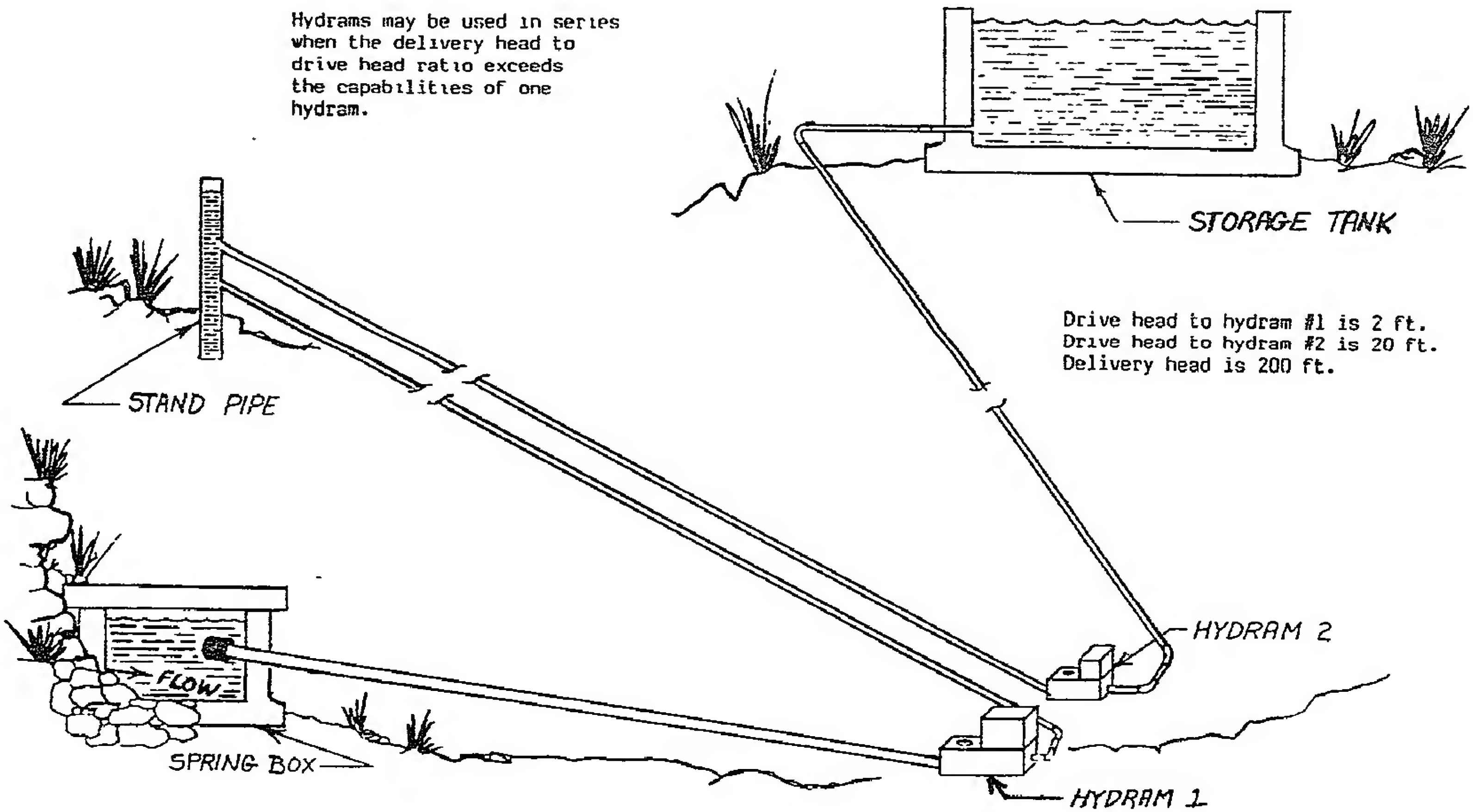
Whole Earth Truck Store
558 Santa Cruz Ave.
Menlo Park, CA 94025
(bibliography list & mail order of anything, almost!)

Procedures:	Notes
1. Introduce session by reviewing limitations of hydram in terms of: - maximum h:H - L:D ratios - cost of galvanized pipe in large sizes State objectives of session.	10 min.
2. Form 3 small groups and assign each group one problem form Handout 16D. Distribute the relevant diagram (16A, B, or C) to the appropriate group.	
The group task is to: - solve problem - determine why single ram will not work - study diagram and determine why the multiple ram arrangement will work - size the multiple ram system - plan 10 minute presentation to the large group	Allow 30 minutes for this.
3. Representatives from each group present and answer questions.	30 min.
4. Ask large group to describe any additional advantages/disadvantages of multiple ram systems, any other situation they might be used in.	10 min.
5. Ask participants what application series/parallel rams have at their sites.	

ATTACHMENT 16-A ~ Site Development

Series Hydram Installation

Hydrams may be used in series when the delivery head to drive head ratio exceeds the capabilities of one hydram.

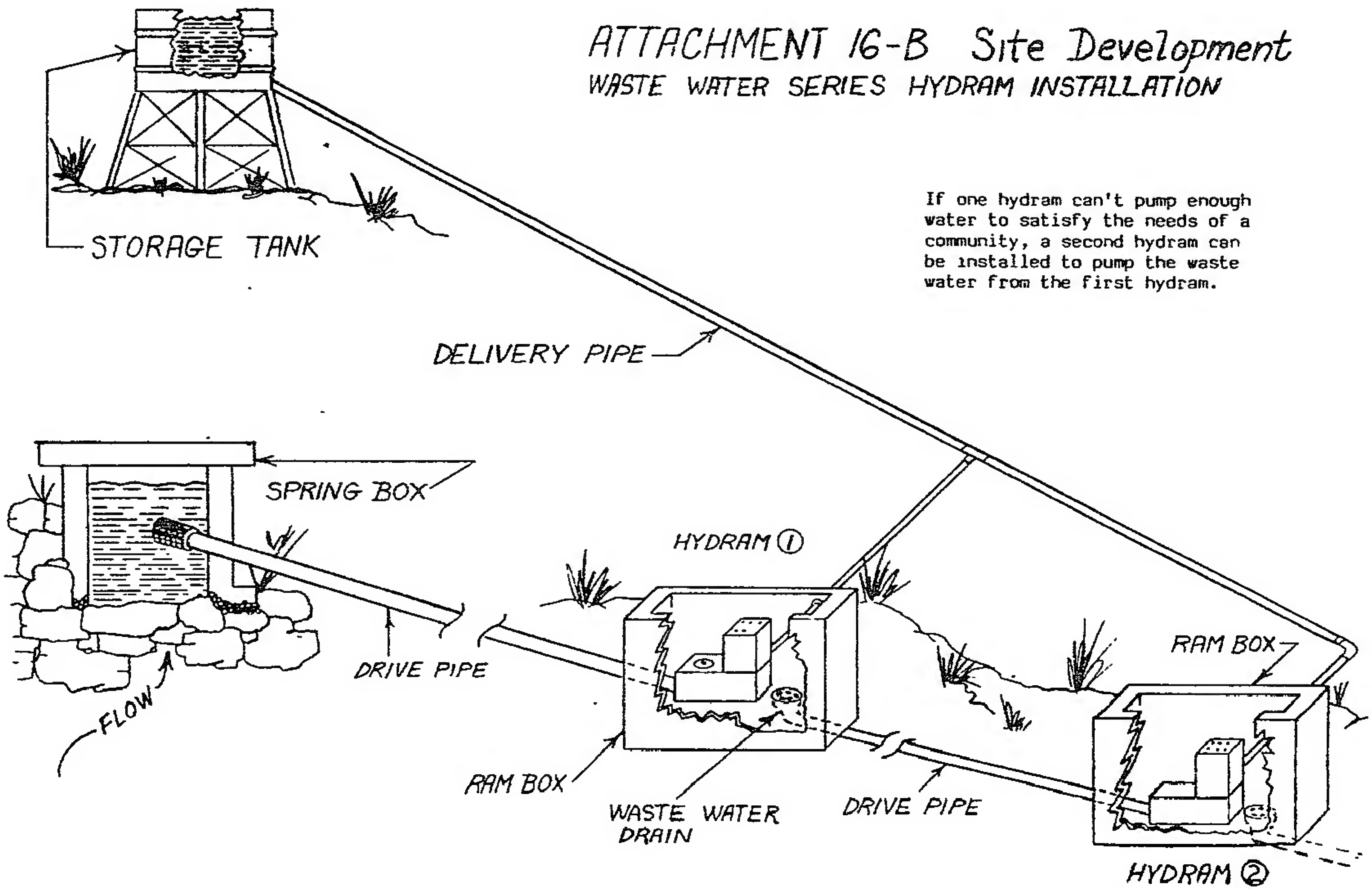


Drive head to hydram #1 is 2 ft.
Drive head to hydram #2 is 20 ft.
Delivery head is 200 ft.

ATTACHMENT 16-B Site Development

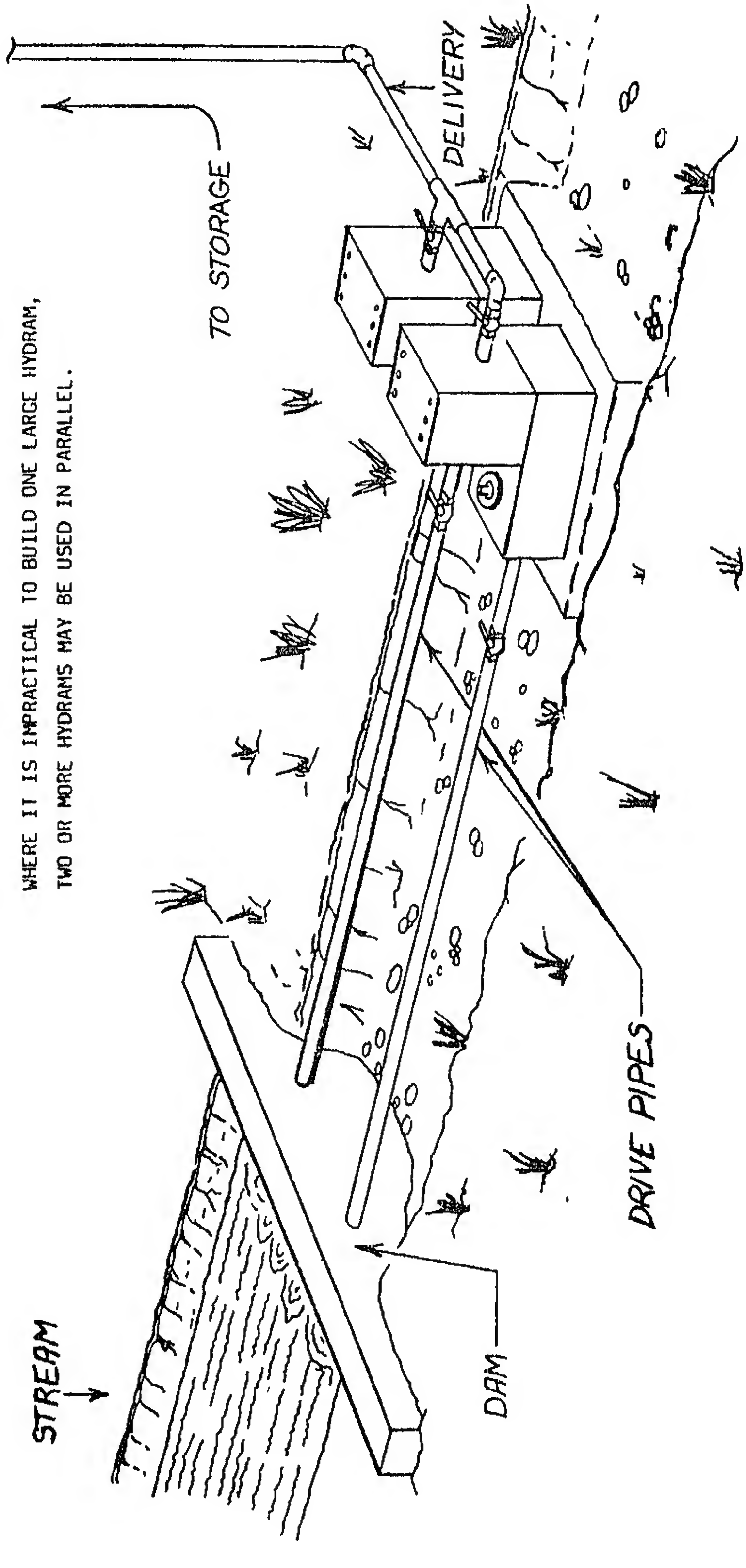
WASTE WATER SERIES HYDRAM INSTALLATION

If one hydram can't pump enough water to satisfy the needs of a community, a second hydram can be installed to pump the waste water from the first hydram.



ATTACHMENT 16-C Site Development

WHERE IT IS IMPRACTICAL TO BUILD ONE LARGE HYDRAM,
TWO OR MORE HYDRAMS MAY BE USED IN PARALLEL.



ATTACHMENT 16D

Problem 16A:

How much water can be pumped to a delivery head of 200 feet, when there is a drive head of 2 feet, a supply of 50 gpm, and an assumed efficiency of 50%?

Problem 16B:

A community of 200 people, with 70 cows, needs 5 gpd per person and 15 gpd per cow. A spring flows at a rate of 15 gpm, H = 10', h = 100', n = 50%, L:D = 960. How can the community's needs be met?

Problem 16C:

How much water can be delivered to a supply tank 50 feet above a hydram when the drive head is 5 feet, the hydrams efficiency is 50%, the flow rate of the water is 30 gpm, and the largest drive pipe available is 2"?

SESSION 17

<u>SESSION 17</u>: <u>Site Development</u> <u>Time</u>: 2 hours

<u>Objective</u>: At the end of this session, participants will be able to:

- describe various construction techniques for the major components of a hydram system, i.e., take off from the source, hydram box, storage facility and necessary piping, and

- develop cost estimates for total systems.

<u>Overview</u>: During this session, participants will describe present construction techniques at their sites and compare them. If participants have little/no experience in water development, simple techniques will be described. This session is <u>not</u> intended to provide construction skills for ram components.

<u>Materials</u>: Handouts
Costs lists developed prior to workshop, especially PVC and galvanized pipe, concrete
Approximate costs developed during construction of hydrams in workshop.
Chalkboard, chalk or flipcharts and markers

Procedures:

1. Introduce the session with a brief statement that so far the workshop focus has primarily been the hydram itself and that we now want to look at a bigger picture, i.e., the system. State the objectives of the session and review Handout 2B. — 10 min.

2. Take off from source.
Ask participants to describe methods they're familiar with for taking water off a stream and/or catching springs. Generate a list of design issues and write these on board/flip chart.

   If participants are not familiar with systems, trainer should describe settling basin, spring catchment, and group should identify in-country resources for developing water sources.

3. Ask participants how to protect hydram itself: keeping drive pipe rigid, free of bends, providing adqequate drainage, avoiding damage by animals, vandals, or to curious people/children. Develop guidelines for construction of hydram box, per Handout. — 10 min.

4. Storage Facility. Repeat Step 2 for storage facilities. — 10 min.

5. Have participants size a ram for their application, and cost out the entire system, using the workshop estimates, their knowledge of skilled labor rates. If participants do not have a specific application in mind, develop a sample problem, using information generated in workshop to date, i.e., — 45 min.

   - cost of rams built
   - maximum h:H for these rams
   - approximate l and L
   - provide hypothetical q

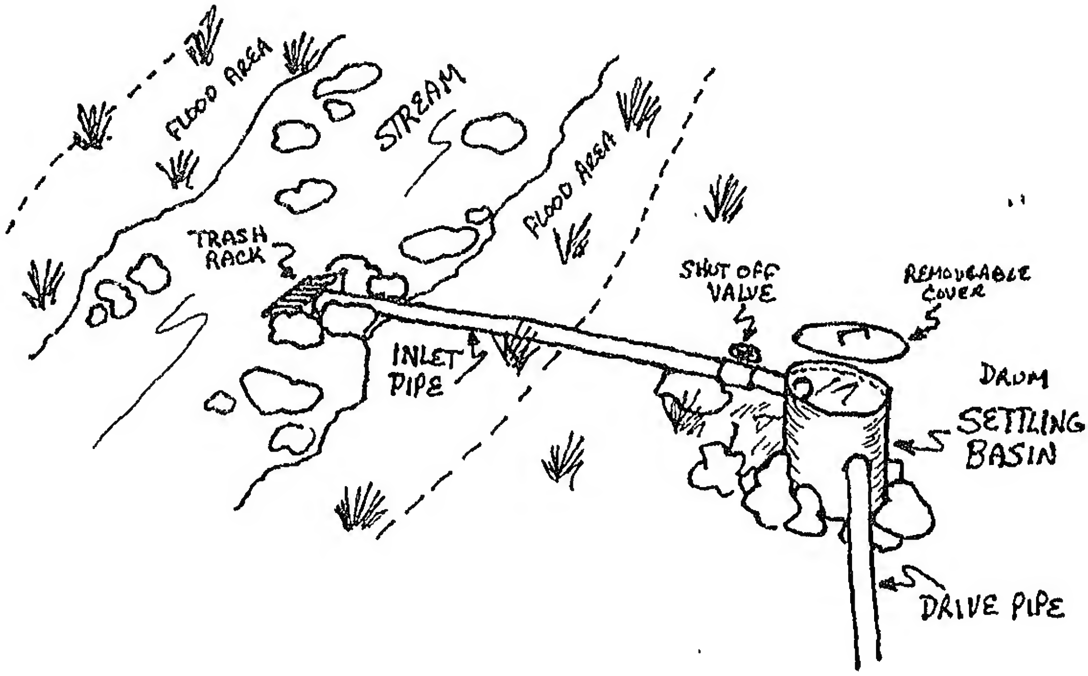
   Check computations to ensure that all components accounted for.

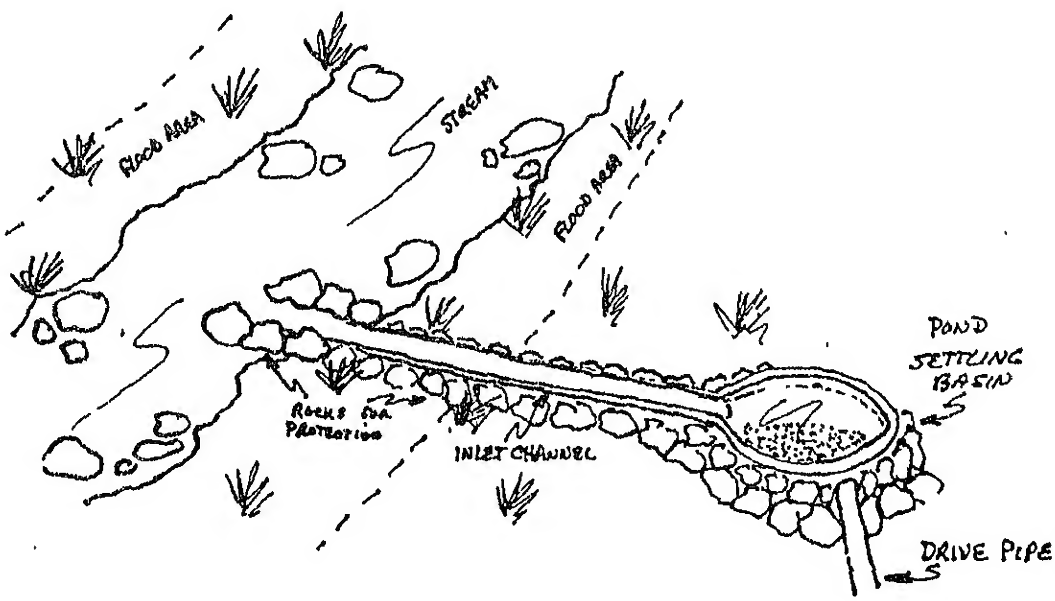
PROCEDURES | NOTES

6. Ask participants what, if any, additional issues are raised by these site development considerations in terms of costs to community, current systems that hydram could run off of, existing storage systems, costs for reticulation.

7. Summarize by stating that all of these must be considered in overall hydram system. Distribute Handouts 17 C, D, and E.

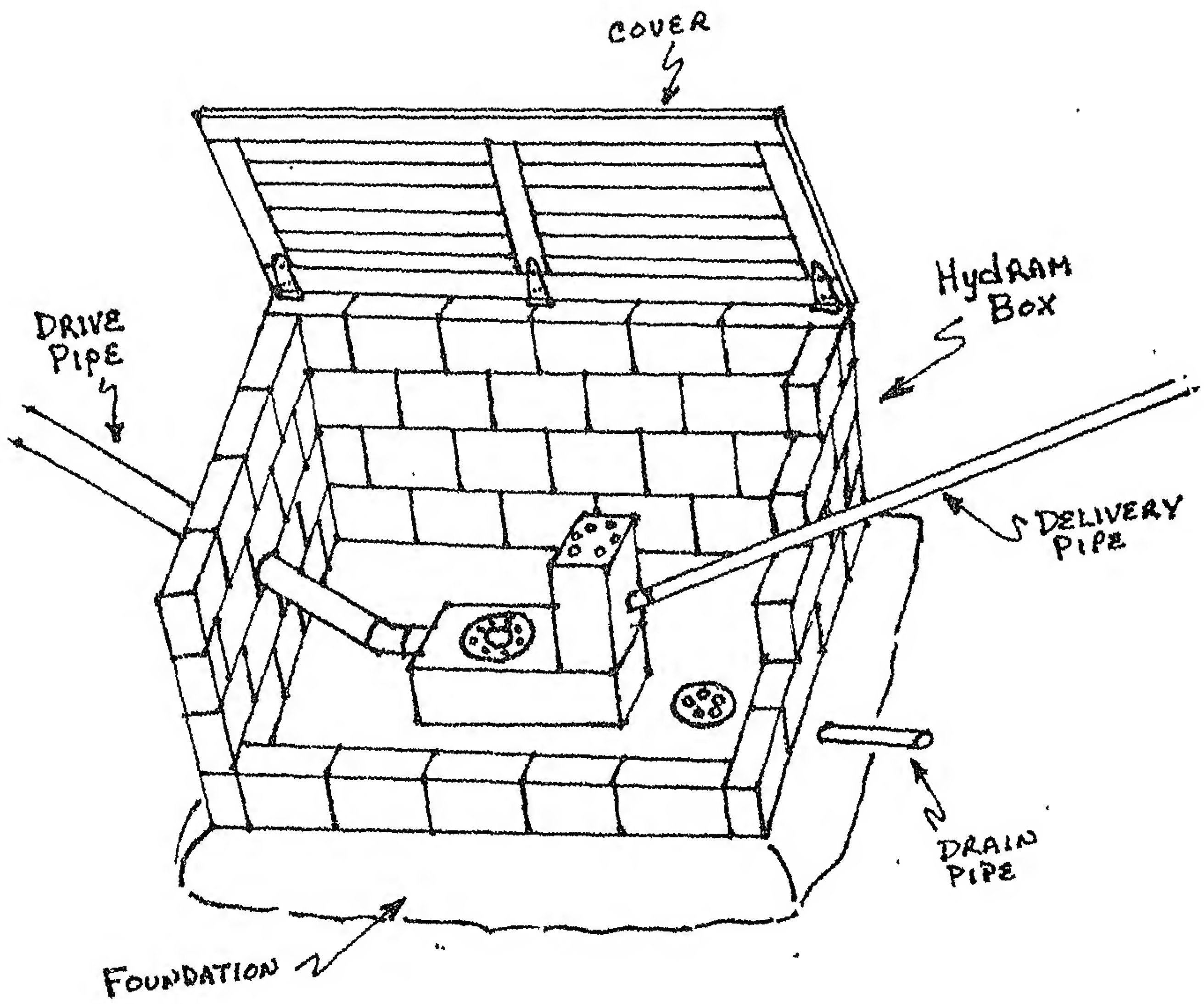
SETTLING AREA - TAKE-OFF SYSTEM





Attachment 17B

HYDRAM BOX



GUIDELINES/CHECKLIST

Take-Off from Source:

materials: pipe or proper soil
drum or tank
plumbing parts (connectors, flanges, etc.)
trash rack
fine mesh screen

concerns: negative slope from source to drum or pond
pipe or channel well into stream
good foundation for durm or pond
means to shut off flow to basin when necessary
keeping trash, debris, sediment out of line
protection from: raging waters
flood
animals
sun (ultra violet rays)
erosion

Hydram:

materials: cement, aggregate, sand
metal pipe and plumbing parts
hydram
metal or wood for cover to box
hinges, screws, etc.
stakes, wire

concerns: support for pipes - drive, delivery
pipe course straight as possible - no 90^{o} bends
anchoring of pipes
drainage for waste water
drive pipe entering settling basin 1/3 way up from bottome of basin
protection box for hydram
drainage for waste water
coverage for all plastic pipes
clear marking of pipeline if buried

Storage Facility:

materials: adequate soil
cement, aggregate, sand
reinforcing bar
paint
pipe
plumbing parts (connectors, faucet, standpipe)
fencing material

<u>GUIDELINES/CHECKLIST</u> - continued

Storage facility - continued

concerns: best match of size, materials and costs
closeness to final usage
durability of tank - strength, seal
protection from animals
safety for users, children

SITE DEVELOPMENT

After the siting of the components for the hydram system has been completed, it becomes necessary to design the components in detail. This session will discuss how to develop them and will allow for a better estimation of the money, labor and time needed.

The components of the system that are of concern here are the take-off from the source, the hydram, the storage facility, and all necessary piping. Variations for developing the components and factors that influence their design will be presented. The attachments to this session will give further guide lines and will give references for those topics that will not be covered in this manual/workshop.

TAKE-OFF FROM THE SOURCE

As was mentioned before, the water for a hydram system is not taken directly from the stream; a take-off component must be installed. Its purposes are to protect the system from the potential damage by floods, to keep sand and debris out of the system and to make maintenance of the system easier. The two basic parts to the take-off area are a settling basin and a transmission channel from the stream to the basin.

The size of the basin has to be just large enough to insure an uninterrupted flow of water to the hydram while trapping sediment, sand, and debris. If the hydram system is small - that is, it uses a 2" drive pipe or smaller, a 55 gallon drum or small tank may be used. If the soil at this site has a good clay content, a small pond can be constructed to serve as the basin. A rough way to determine the size of the basin is to determine the volume of water contained in the drive pipe at any point in time and have the basin be large enough to allow 3-4 times that volume of water standing above the drive pipe, e.g., if the drive pipe contains 10 gallons (area of the inside diameter of the drive pipe times its length), then a basin with 30-40 gallons above the drive pipe inlet will be sufficient. The inlet of the drive pipe should be positioned at least 1/3 of the way up from the bottom of the basin. A fine mesh screen must cover the inlet of the drive pipe (keeps frogs, etc. out).

The second part to the take-off is the channel or pipe that takes the water from the source and directs it to the basin. If a drum or tank is used as a basin, a pipe is more suitable as the inlet channel in that the pipe lends itself to an easier attachment to the drum/tank. If a pond is used, a dug channel can be used. The channel however, may need to be lined with clay to minimize seepage loses through the soil. The channel or pipe should be placed well into the stream to be able to pick up sufficient water during the dry season. The pipe needs to be anchored to the streambed for protection from being swept away by raging

waters during the rainy season. A channel also will need to be protected. In both cases, large rocks placed on each side of the channel/pipe should be sufficient.

The channel will need more regular maintenance than a pipe to keep the sediment and weeds from blocking the passage. The pipe will need a trash rack in front of it's stream opening to keep debris, fish, etc. out of it.

The channel/pipe will need to have a slight negative slope to it - 1% or so to allow the water to naturally feed into the basin. Both the channel and the pipe should have some means of blocking the flow of water to the system when that becomes necessary. If a plastic pipe is used, it will have to be covered to protect it from the sun; the ultraviolet rays of the sun will eventually destroy the plastic.

One last note: if the stream under consideration has excellent year round flow rates, but not an adequate head to run the hydram, a small dam may need to be constructed. This is a costly undertaking - in terms of money, time, skill and labor. This manual/workshop cannot provide the necessary information for working with a dam. You will need more information to help decide if further consideration of the project is worthwhile.

The Hydram

The hydram component consists of the drive pipe, the hydram itself, the delivery pipe and a protection box/foundation for the hydram. Details about development and construction of the hydram are covered in this manual.

The drive pipe needs to be made of metal to withstand the pressures and pounding that develops in running the system. It should be positioned in the settling basin about 1/3 the way up from the bottom. The pipe should be well supported along its length and protected from outside disturbances. If stakes can be driven into the ground, the pipe can be anchored to them; this will help minimize vibrations and keep it from being bumped off its supports. The pipe should transverse as straight a course as possible. In no case should sharp bends (90°) be used; 45° bends or less should be used. If they are used, support must be provided at each bend to keep the sideway thrusts that will develop inside the pipe at that point from destroying the line.

The delivery pipe can be made of plastic. The same care in supporting, anchoring and protecting the drive pipe should be applied also to the delivery pipe. The course of the pipe should be as straight as possible, avoiding all sharp bends. An additional concern with plastic pipe is protection from the ultraviolet rays of the sun. The pipe needs to be covered. One way to

do this is to bury it. However, if this is done, the channel should not be covered up until the system is working and the pipe checked for leaks.

The delivery pipe, because of its length, may raise additional concerns. It must be adequately protected any place it has to cross a trail or road, or in other ways is subject to possibly being run over by a cart or vehicle. If it crosses cultivated land, it's course must be adequately marked so that it is not accidently damaged during cultivation operations.

The hydram itself must be well supported and protected from accidental disturbances. In addition the waste water needs to be directed away from the support foundation. The best way to provide this protection is to build a concrete foundation with drain outlet and a concrete or cement block box around it. The box should be large enough to allow enough room for a workman (or two) to comfortably move around the hydram. If a concrete hydram is used, the accumulator and/or the body may weigh a couple of hundred pounds. If it has to be removed for some reason, there must be enough room in the box to allow workers to get in there and lift it out.

The final part to the box should be some type of cover that can be locked; this offers protection from vandals or people tampering with the hydram out of curiosity. A final note on the construction of the box: the foundation should be poured and the hydram installed. After the hydram is working like it should, the walls to the box should be constructed and the cover installed.

The Storage Facility

The construction design of this component of the system is dictated by its size, the available materials, and physical characteristics of the site. A few examples may highlight some design considerations for the storage facility:

Let's say your calculations for the system indicate that 1000 gallons of water a day needs to be delivered. To store this amount of water, the facility will need to be about 12 feet on a side and 12 foot high. (1 cubic foot of water equals 7.48 gallons) If you want to have a 3-day supply of water (1 day's use and 2 days in reserve) the facility will need to be at least 12' x 12' x 3'. It may be economically reasonable to construct this out of concrete and block.

Now let's say the system will be used for irrigation and will need to store 100,000 gals and use it every 8 days. The size of this facility will need to be approximately 40 feet on a side and 3 feet high. To construct this structure out of concrete may be too costly; a pond would have to be constructed. (Incidently, a system needing 2100,000 gallons every 8 days will need to pump

about 10 gals a minute, all day, every day. 100,000/8days/24 hours/60 minutes.)

This manual/workshop can not go into all the details and procedures necessary to construct these storage facilities. However, some reference materials are listed in the attachments that can assist in this work. In addition, assistance can be obtained from the agriculture department and technical donor groups/agencies.

Irrespective of the design of the facility, there are basic concerns for the protection of the system and for safety to the individuals using it. A pond almost assuredly will have to have a fence around it to keep animals and little children out of it. The walls of a tank will have to be reinforced with metal bars and the inside of the tank plastered with cement and painted to prevent leaks.

Cost and Labor Considerations

The labor for and the costs of this system can be quite a burden for the rural farmer or village; this is why the siting and the design of the system are so important. When both are done with care and skill, the costs for a completed system will be as low as possible. It should be obvious that with ample free/cheap labor and proper soil available the system can be kept within reasonable limits. It should also be obvious that the amount of labor needed and the length of time to do it all can be extensive.

It may be useful to take an example and see what a system might cost. Prices for everything are different everywhere, but for the sake of this example, let's say:

- Cement costs $7/bag - 1 bag can make 20 blocks 16" x 8" x 8"; can plaster 50 sq. ft. of surface can bond 35 blocks together; can produce 6 cu. ft. of concrete
- Reinforcing bars for the total system costs $75
- Metal pipe costs $8/foot
- Additional plumbing parts $75.
- hydram can be built for $100
- Plastic pipe costs $4/foot
- 55 gal drum costs $10
- welding work on drum costs $15

- Pipe lengths are: inlet line to drum 20'
  Drive pipe 40', delivery pipe 200', supply pipe 300'
- Hydram box needs to be 6' x 5' and 4 courses high
  foundation - ½ foot thick
- Storage facility needs to be 15' x 15' x 4'
  foundation - 1 foot thick
- Paint $50
- standpipe and faucet at final use point $100
- Transportation costs $200
- no labor costs

What will this system cost? (round off fractions to next highest whole number.)

If the storage facility will be a pond with no material costs, what will the system cost? (Transportation costs are cut in half; no reinforcing bar is needed.)

If, in addition, the supply line isn't needed, what will the system cost?

GLOSSARY OF TERMS FOR SESSION 17

Battery of hydrams - (or parallel hydrams) a hydram installation where two or more hydrams are connected to the same source with different drive pipes, but usually with the same delivery pipe. This type of installation is used where the size of the hydram is limited.

Holding tank - (storage tank) the means of storing water once it has been pumped to the desired head.

Ram box - the small structure usually made out of concrete and/or wood which houses a hydram, protecting it from freezing, weathering, and possibly from vandalizing.

Series hydram - a hydram installation where two or more hydrams are used in series to pump water higher than one hydram could alone.

Spring box overflow pipe - a pipe placed in the wall of a spring box near the top for unused water to exit through.

Waste water drain - the drain in the bottom of a ram box which allows the waste water from the hydram to drain out.

Waste water series hydrams - a hydram installation where one hydram uses the waste water from another as a source to pump a higher percentage of the water.

SESSION 18

SESSION 18: Hydram System Site Selection Time: 2-4 hours

Objective: At the end of this session trainees will have selected a site for a hydram system from a range of possibilities, based on the technical, social and economic factors involved in the decision.

Overview: This session pulls together several issues that have been identified over the course of the workshop: technical feasibility, water need, access, skills, cost, community responsibility, maintenance and repair.

There are two possible activities described here:

1) a hypothetical exercise, with a hillside full of springs as possibilities

2) a field activity in a pre-selected location which presents several options for siting the system.

Note: Activity 2 is optimal and requires site identification by the trainer, concurrence for using the area (from local residents, officials, etc.). It takes much more time and makes a richer activity.

Materials:

- For hypothetical activity, Handout 18A
- For actual field activity: site levels, tapes, weirs or estimated flow rates for source

Procedures

1. State objectives of session and overview of activities.

2. Ask what are the major components of a hydram system that needs siting, and what are the major factors that influence the selection of a site.

3. Ask what information should be known about the project before site selection can be made. List on flip chart.

4. Ask what factors and components should be looked at, in what order.

5. Present actual or simulated situation and instruct participants that they will have to select a site.

Actual:

- Divide into groups of 4-5. Ask groups to spend 30 minutes organizing their tasks, responsibilities for gathering data at the site, and decision making process.

- go to site, gather data, make decision and prepare presentation/recommendation including rationale, need, cost.

- Each group presents, and large group critiques based on factors listed above.

Especially if field activity is used. Note any concerns raised during this discussion

15 min.
Head needed for system, flood boundaries of stream, ownershi[p] of land, cost of pipe of diff[erent] materials and in different si[zes]
1. hydram & head should be fi[rst] then flood consideration
2. Take off point and distance D_1 to hydram; flood considerat[ion]
3. Social factors for hydram a[nd] take off system
4. Storage facility and distan[ce]
5. above with social factors
6. Cost of above system
7. Distance, d_3 and costs
8. Maintenance responsibilitie[s] access.

30 min.

1½ - 2 hours. Trainers should monitor time.

<u>Simulated</u>

• Individually, using handout 18A, and given spring flow rates, distances, select site for locating hydram, to deliver 1500 gpd. Solve for single ram first then consider series installation.	In this situation, its difficult to consider all social factors 30 min.
• Develop approximate costs.	20 min.
• Ask for responses; differences. Ask 1-2 participants with different answers to share rationale	20 min.
6. Ask participants which issues are of major concern at their sites.	

INSOLATION METER CONSTRUCTION

Total time: 2 hours

Objectives:

* To build and use a simple insolation meter
* To begin to gather data on insolation for future application to solar projects

Resources:

* Anderson, Bruce, The Solar Home Book, pp. 58-62, 173-174
* Mazria, Edward, The Passive Solar Energy Book, pp. 13-20
* Baer, Steve, Sunspots, pp. 118-125
* Attachment II-9-A, "Insolation Meter Data Collection Sheet"
* Attachment II-9-B, "Insolation Meter"

Materials: Newsprint and felt-tip pens, metric scale 0-30 kg, thermometers (0^{o}C), tape (or other fasteners), saws or knives, insulating material (rigid foam insulation, straw, newspaper, etc.), clear glazing material (glass, vinyl, etc.), 20-liter tin cans or other containers, flat black paint, paint brushes, paint thinner, sample insolation meter

Procedures:

Step 1. (10 minutes)
Begin the session by posting the words "Insolation Meter" on newsprint and asking the participants to define "insolation" and "insolation meter."

Step 2. (5 minutes)
Facilitate a brief discussion of the terms "units of insolation" and "kilogram calorie," and provide an overview of the different units of measuring insolation in different countries.

Step 3. (5 minutes)
Display the sample insolation meter. Have the participants discuss how to locate and align the insolation meter.

Trainer Notes

It is important that the participants discuss these three basic guidelines for location and alignment:

Continued

Trainer Notes/Continued

The insolation meter should:

1. Be placed in a good potential solar site with maximum exposure to the sun year-round.
2. Face the equator;
3. Be tilted to maximize insolation (See Phase III: Session 2, "Path of the Sun").

Step 4. (5 minutes)
Explain the basic guidelines for collecting data from an insolation meter.

Trainer Notes

Point out that in order to collect data from the insolation meter:

* The glazing area should be covered, with the exception of a one or two hour period when data are being collected.
* The insolation meter works best at low water temperatures and for short exposure periods (overheated water and heat loss from the meter will cause the data to be misleading).
* Water temperatures should be recorded twice during each test period -- at the beginning and at the end. The difference between these two temperatures is referred to as "T" or "Delta Tee."
* Data should be recorded on the "Insolation Meter Data Collection Sheet."

Step 5. (10 minutes)
Distribute Attachment II-9-A and allow time for the participants to review it as well as the accompanying sample sheet.

Trainer Notes

Review each step of the sample sheet with the participants, answering any questions. Explain that they should be recording their data over the next several weeks and that this data will ... applied during the solar phase of the training program.

(90 minutes)
te Attachment II-9-B, "Insolation Meter."
participants form small work groups of
eople and build and place an insolation

Trainer Notes

Be sure there are adequate building materials for each work group. Post the following checklist for the construction and use of an insolation meter:

_____ Paint at least one face of the can flat-black.

_____ Fill the can no more than 90% full to allow for expansion of the water.

_____ Weigh the can full of water in kilograms.

_____ Seal the box tightly.

_____ Be certain the glazing is well-sealed.

_____ Measure the collection aperture in square meters.

_____ Be sure the thermometer can be read without dismantling the meter.

_____ Be sure the meter is properly oriented.

_____ Be sure the meter is properly tilted.

_____ See that the glazing can be completely covered at night.

INSOLATION METER DATA COLLECTION SHEET

Name:
Location:
Orientation (compass direction):
Tilt (degrees from horizontal):
Weight (in kilograms):
Aperture (in square meters):
Weight/Aperture:

Date	Weather Conditions	Time	Temp (^oC)	$\frac{\Delta t}{hr}$	$\frac{Kgcal}{m^2\ hr}$	$\frac{\Delta t}{day}$	$\frac{Kgcal}{m^2 day}$

Hourly Insolation: $\frac{(Kgcal)}{m^2/hr} = \frac{\text{Weight (kg)} \times \Delta t/hr \quad (^oC/hr)}{\text{Aperture of meter } (m^2)}$

Daily Insolation: $\frac{Kgcal}{m^2/day} = \frac{\text{Weight (kg)} \times \Delta t/hr \ (^oC/day)}{\text{Aperture of meter } (m^2)}$

Note that weight and aperture are constants. The only variable is Δt. Therefore, to find insolation, multiply weight/aperture by the Δt.

INSOLATION METER DATA COLLECTION SHEET

Name:
Location:
Orientation (compass direction): True South
Tilt (degrees from horizontal): 45°
Weight (in kilograms): 20
Aperture (in square meters): 0.1
Weight/Aperture: 200

SAMPLE

Date	Weather Conditions	Time	Temp (°C)	$\frac{\Delta t}{hr}$	$\frac{Kgcal}{m^2\ hr}$	$\frac{\Delta t}{day}$	$\frac{Kgcal}{m^2 day}$
6-10	Clear	8 AM 9 AM	16 17	1	200		
6-11	Clear	9 AM 10 AM	16 18	2	400		
6-12	Clear	10 AM NOON	16 22	3	600		
6-13	Cloudy						
6-14	Clear	11 AM NOON	16 19	3	600		
6-15	Clear	NOON 1 PM	17 21	4	800		
6-16	Clear	1 PM 3 PM	17 26	4.5	900		
6-17	Clear	2 PM 3 PM	18 21	3	600		
6-19	Clear	3 PM 4 PM	17 19	2	400		
						22.5	4500

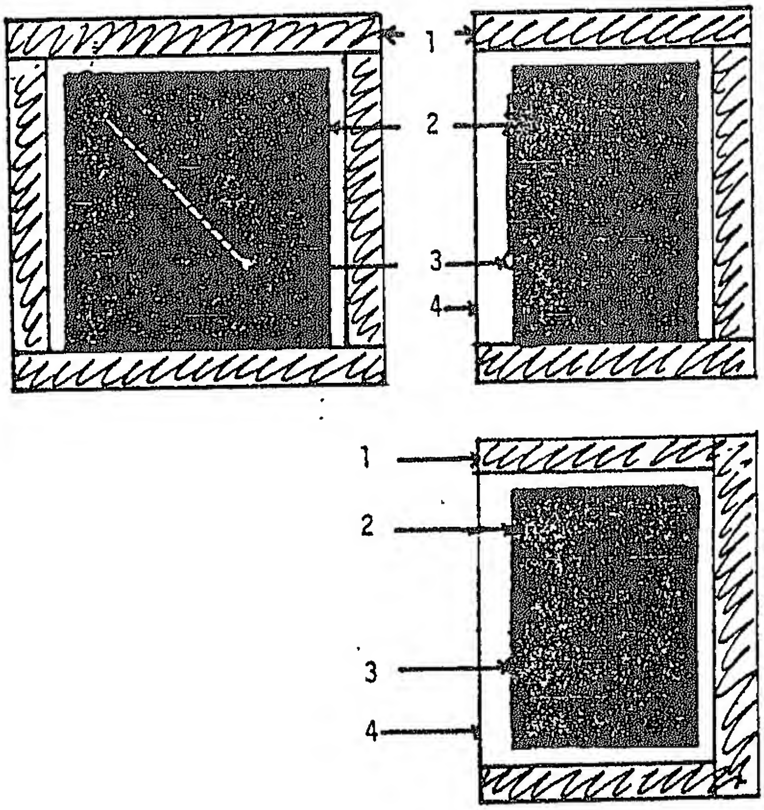
<u>Hourly Insolation</u>: $\frac{(Kgcal)}{m^2/hr} = \frac{\text{Weight (kg)} \times \Delta t/hr\ (^{\circ}C/hr)}{\text{Aperture of meter } (m^2)}$

<u>Daily Insolation</u>: $\frac{Kgcal}{m^2/day} = \frac{\text{Weight (kg)} \times \Delta t/hr\ (^{\circ}C/day)}{\text{Aperture of meter } (m^2)}$

Note that weight and aperture are constants. The only variable is Δt. Therefore, to find insolation, multiply weight/aperture by the Δt.

INSOLATION METER

Front View   Side View

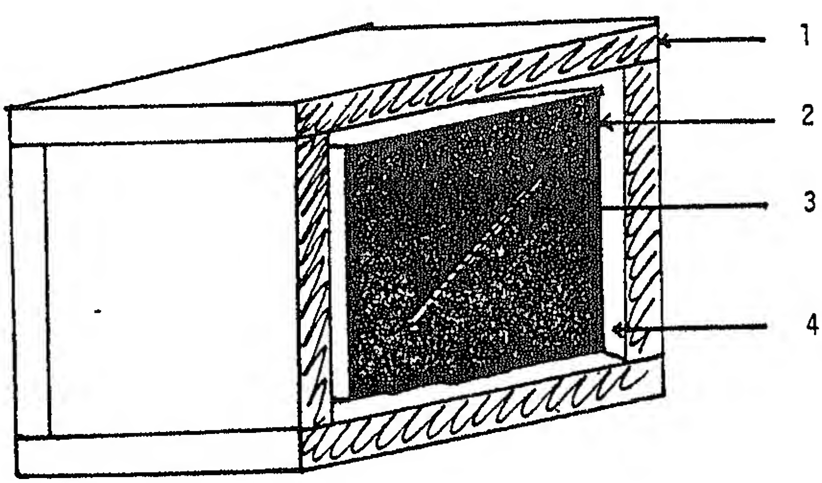


Top View

KEY

1. Insulation
2. Black-painted can
3. Thermometer
4. Glazing

Isometric View



COOKSTOVE CONSTRUCTION
PART 1: CONSTRUCTING THE BASE

Total time: 1 hour

Objectives:

* To build a sand/clay cookstove as described in the previous session
* To construct the base of a sand/clay cookstove (optional)

Resources: Evans and Boutette, Lorena Stoves, pp. 50-51

Materials: Clay, sand, water, rubble, earthen blocks/brick/concrete rubble/soil-cement blocks/mortared rocks, sifter, shovel, hoe, machete, trowel, lumber

Procedures: Step 1. (1 hour)
Ask the participants to form the same work groups as in the previous session and to lay out and construct an appropriate stove base using the materials provided.

Trainer Notes

Each group should construct a base for one of the three suggested cookstoves to be built during this phase: the Lorena, the Louga and the Java Chimneyless.

Explain that the stove base should be solid and not shift. Also mention protecting the base from erosion due to surface runoff of water.

Give participants a variety of suggestions, i.e., a level ground base, clay-mortared earthen blocks, cinder blocks, etc.

Encourage the groups to be creative in their use of materials and to try new approaches. Explain that they should feel free to do this at all stages of the stove construction.

Before the groups begin construction, mention that they should limit the size of their stove (generally the largest being two pots with a chimney) to be certain there will be time to complete the project.

COOKSTOVE CONSTRUCTION
PART 2: BUILDING THE STOVE MASS

Total time: 6 hours

Objective: To construct the mass of a sand/clay cookstove

Resources: Evans and Boutette, Lorena Stoves, pp. 50-57

Materials: Clay, sand, water, sifter, machete, trowels, shovels, hoes, tampers, lumber

Procedures: Step 1. (6 hours)
Have the work groups construct the stove masses.

Trainer Notes

Tell the work groups they have six hours to complete the stove.

Outline the procedure for building the stove bodies in the following manner:

* Sift sand and clay through a 5mm or 3mm (3/16" or 1/8") screen mesh.
* Mix the dry ingredients to the desired proportions.
* Add water and mix well.
* Apply the mixture to the stove base.
* Add one layer to another, packing each layer well, paying special attention to the edges and being careful to keep the sides straight.
* Continue adding layers until the stove mass attains a height of 30-40cm, depending upon the depth of the pots to be used and the height of the firebox.
* Trim the stove mass sides and fill in mixture where needed.
* Level the surface by gently pulling a wet board back and forth over the surface until it is flat and smooth.

Circulate among the work groups and assist them in the construction process where necessary. Encourage group members to rotate tasks in order to gain experience in all phases of the construction.

Ask the participants to read Lorena Stoves, pp. 58-65, before the next session.

COOKSTOVE CONSTRUCTION
PART 3: FINISHING THE COOKSTOVE

Total time: 3 hours

Objective: To excavate the potholes and tunnels of an earthen cookstove

Resources: Evans and Boutette, Lorena Stoves, pp. 58-65

Materials: Machete, trowel, spoons, nails, sheet metal, wood (for dampers) and chimney pipe (if required)

Procedures: Step 1. (3 hours)
Briefly review the process of excavating and finishing an earthen cookstove. Have participants form their work groups and complete their stoves.

Trainer Notes

Mention that they have three hours to complete their stoves.

Outline the process in the following manner:

* Using the actual pots as templates, position and mark the potholes.
* Locate and mark the position of the damper slot and chimney hole (if necessary).
* Cut the damper slots with a machete.
* Carve out the potholes and chimney with a spoon.
* Cut the firebox entrance and connecting tunnels to the last pothole or chimney hole.
* Finish the potholes with spoons and by rotating the wet pots so that the pots are deeply sunken.
* Build up the baffles under the second and third potholes.
* Construct and insert the dampers.
* Smooth the stove surfaces.

Circulate among the groups offering assistance whe

Refer the work groups to Lorena Stoves, pp. 58-65, specific information on completing the stoves.

NATURE OF VOLUNTEERISM: EXPECTATIONS BEYOND TRAINING

Total time: 2 hours

Objectives:

* To discuss and clarify expectations regarding future Peace Corps service
* To plan, carry out and evaluate a training activity using a format for training design

Materials: Newsprint and felt-tip pens

Trainer Notes

> The basic format for this session is the same as the format for Phase I: Session 5, "Development of Facilitation Skills Criteria." You should review Session 5 before beginning this one.

Step 1. (5 minutes)
Begin by explaining the session objectives and reviewing the procedures. Encourage questions and discussion.

Trainer Notes

> Explain that the procedures for this session are essentially the same as the procedures for the session on the development of criteria for facilitation skills. As in the previous session, participants will be involved in two processes simultaneously. That is, they will be planning, carrying out and evaluating a training activity while discussing and clarifying some of their expectations regarding future Peace Corps service.

Step 2. (10 minutes)
Post the training design format and explain how it will be used in this session.

Trainer Notes

> Post the following training design format:
>
> 1. Identify and agree upon objectives.
> 2. Identify available resources.
> 3. Design an activity/ies to meet the objectives.
> 4. Evaluate the success of meeting the objectives.
>
> Explain that the remaining steps in this session will consist of using this format to enable participants to discuss and clarify some of their expectations regarding future Peace Corps service.

FOOD ISSUES

Total time: 2 hours

Objectives:

* To compare and contrast the typical diet of the United States with that of diets in developing countries
* To define and discuss cash cropping and subsistence farming
* To identify and discuss a "food first" approach

Resources:

* Werner and Bower, Helping Health Workers Learn
* Gussow, The Feeding Web, pp. 122-125, 163-166, 168
* Bullfrog Films, "Toast"
* Institute for Food & Development Policy, "Food First," a sound slide show

Materials: Newsprint and felt-tip pens, chalkboard/chalk, film projector and tape recorder

Procedures:

Trainer Notes

* Have the participants read the listed resources prior to the session. If copying is not possible, place the resources on reserve and have a scheduled check-out system so that participants can review the materials.
* If they are not available, the film ("Toast") and slide show ("Food First") mentioned in Steps 4 and 6 can be substituted with analysis of related reading.

Step 1. (5 minutes)
Present the session objectives and outline the activities.

Step 2. (15 minutes)
Have the participants brainstorm a list of qualities and meanings for the word "food."

Trainer Notes

Write their responses on posted newsprint (e.g., "Food" is . . nutrient, commodity, healing, sharing, sacred, festive, weapon, power, symbolic, etc.)

Step 3. (10 minutes)
Assist the group in identifying and agreeing upon some specific objectives which focus on the general goal of discussing expectations regarding future Peace Corps service. List these objectives on newsprint.

Step 4. (10 minutes)
Help participants identify any resources which may be available.

Trainer Notes

Some resources might include: returned Peace Corps Volunteers, current volunteers, written statements by current or ex-volunteers, films or books about Peace Corps service, etc.

Step 5. (15 minutes)
Have participants design an activity/ies which meets their objectives and utilizes the available resources.

Trainer Notes

* Activities which you can suggest include: a panel discussion with current or returned volunteers, a brainstorm and discussion of expectations, small group discussions, etc.

* Suggest that the procedures for the activity be outlined, that time limits be set and that a timekeeper, recorder, observer and facilitator be chosen.

Step 6. (60 minutes)
Have participants carry out the activity according to their design.

Step 7. (10 minutes)
Evaluate the success of meeting the objectives of the activity.

Trainer Notes

Encourage discussion by asking the following questions:

* Was the activity well designed? If so, how? If not, how could it have been improved?

* In carrying out the activity, were the procedures followed?

* What were some things that the facilitator did to help the process? What did he/she do that hindered?

THE ROLE OF THE VOLUNTEER IN DEVELOPMENT: DEFINITION OF APPROPRIATE TECHNOLOGY

Total time: 2 hours

Objective: To determine criteria for appropriate technologies in developing countries

Resources:

* deMoll, Lane and Coe, Stepping Stones: Appropriate Technology and Beyond

  Selections from the above publication:

  Bender, "Changing Possibilities," pp. 9-10

  Bender, "New Values," pp. 47-51

* Reddy, Technology, Development and the Environment: A Re-Appraisal, "Criteria for the Selection of Technology," pp. 217

Trainer Notes

> Sufficient copies of the resource materials should be prepared for distribution during this session.

Materials: Newsprint and felt-tip pens

Procedures:

Step 1. (5 minutes)
Provide a brief introduction by reviewing the session objectives.

Step 2. (10 minutes)
Have participants write down their own individual definitions of "appropriate technology."

Step 3. (20 minutes)
Have participants form groups of up to 5 people and develop a list of the major criteria for appropriate technology in the United States.

Step 4. (45 minutes)
Distribute copies of "Changing Possibilities" and "New Values" and have the groups:

* Read these articles.
* Discuss how the definition of appropriate technology may differ in developing countries.
* Revise their criteria lists accordingly.

Step 3. (15 minutes)
Assist the participants in generating and comparing lists of foods that could be considered "typical" in the United States and "typical" in developing countries.

Trainer Notes

Post the two lists on newsprint and discuss significant similarities and differences.

Have the participants identify and discuss those foods typical to the United States that are healthful and nutritious and those that are not.

Stimulate discussion by asking:

* How has the typical United States diet changed over the last two generations? Why has it changed?

* Has the typical diet of developing countries changed? Why? Why not?

Step 4. (20 minutes)
Show and discuss the film, "Toast."

Step 5. (15 minutes)
Have the participants define and compare "cash cropping" and "subsistence farming."

Trainer Notes

Write the definitions on newsprint. You can focus the activity by using the following categories: purpose, goal, effects, energy use, sustainability, etc.

Refer participants to the lists of qualities and meanings from Step 2 and ask how they relate to the two approaches.

Step 6. (45 minutes)
Present and discuss the slide show, "Food First."

Trainer Notes

The following questions will focus the discussion:

* What are the implications of "food as commodity" approach to health and well-being?
* How is a "food first" approach possible?
* What are some ways appropriate community technologies can further a "food first" approach?

Step 7. (5 minutes)
Conclude by reviewing the session objectives.

THE ROLE OF THE VOLUNTEER IN DEVELOPMENT: DEFINITION OF APPROPRIATE TECHNOLOGY

Total time: 2 hours

Objective: To determine criteria for appropriate technologies in developing countries

Resources:

* deMoll, Lane and Coe, Stepping Stones: Appropriate Technology and Beyond

  Selections from the above publication:

  Bender, "Changing Possibilities," pp. 9-10

  Bender, "New Values," pp. 47-51

* Reddy, Technology, Development and the Environment: A Re-Appraisal, "Criteria for the Selection of Technology," pp. 217

Trainer Notes

> Sufficient copies of the resource materials should be prepared for distribution during this session.

Materials: Newsprint and felt-tip pens

Procedures:

Step 1. (5 minutes)
Provide a brief introduction by reviewing the session objectives.

Step 2. (10 minutes)
Have participants write down their own individual definitions of "appropriate technology."

Step 3. (20 minutes)
Have participants form groups of up to 5 people and develop a list of the major criteria for appropriate technology in the United States.

Step 4. (45 minutes)
Distribute copies of "Changing Possibilities" and "New Values" and have the groups:

* Read these articles.
* Discuss how the definition of appropriate technology may differ in developing countries.
* Revise their criteria lists accordingly.

Step 5. (30 minutes)
Reconvene the groups and have a representative from each one present and discuss their lists.

Trainer Notes

Stimulate discussion regarding the lists by calling attention to the following questions:

* Are the criteria for "appropriate technologies" in the United States significantly different from those in the developing world? If so, why? If not, why not?

* What are some potential political implications of development of "appropriate technologies" in the United States and in the Third World?

Step 6. (10 minutes)
Conclude the session by distributing the "Criteria for the Selection of Technology" and explaining that its purpose is to provide a final perspective on possible criteria for "appropriate technology."

Trainer Notes

Explain that they should keep these lists for use as reference in designing their various appropriate technology devices throughout the program.

STOVE PROMOTION AND DISSEMINATION

Total time: 2 hours

Objectives:

* To identify and discuss the advantages and disadvantages of various development approaches
* To discuss various approaches to stove promotion, dissemination and information-gathering

Resources:

* Aprovecho Institute, Helping People in Poor Countries, pp. 35-77
* Attachment III-14, "Stove Introduction and Dissemination: Case Studies 1 and 2"

Materials: Newsprint and felt-tip pens, chalkboard/chalk

Procedures:

Step 1. (5 minutes)
State the session objectives and outline the activities.

Step 2. (10 minutes)
Distribute Attachment III-14 and have the participants read it.

Step 3. (1 hour)
Have the participants identify and discuss the advantages and limitations of the development approaches described in each case study.

Trainer Notes

* On newsprint, record the advantages and disadvantages of each development approach as it is raised.
* Encourage any conclusions or observations from the participants.
* Point out that there is no clear, correct approach. There are advantages and disadvantages to all approaches.
* Stress the following guidelines:
  Learn about the community.
  Discover existing needs, resources, ideas and methods of problem-solving.
  Use a participatory, dialogue approach in working with a community or other groups.

Step 5. (40 minutes)
Discuss various approaches to information-gathering, stove promotion and dissemination.

Trainer Notes

Encourage discussion by asking:

* Assuming a need for cookstoves (or stove improvement) exists, how would you help a program get started?

* Then, how would you get people interested in cookstoves?

Some responses that may be generated are:

* Assess the needs and receptiveness of villagers.

* Establish rapport and trust in the community.

* Assess local resources, i.e., materials, skills (potters, mason).

* Examine other development programs in the community, analyzing the community's receptivity to change, amount of free time, etc.

Additional questions that could be raised during the discussion are:

* How would you promote the development of a national stove program?

* What would be a good location for a stove demonstration center. What would it do? What would be the drawbacks of a regional or local center?

Step 6. (5 minutes)
Have a participant summarize the key points of the discussion.

Trainer Notes

Refer the participants to Helping People in Poor Countries, Chapters III and IV, for additional information, background and ideas.

STOVE INTRODUCTION AND DISSEMINATION: CASE STUDY 1

A volunteer health worker in a small town in the Sahel noticed many women suffering from the smoke in their kitchens. Remembering the wood stoves she had seen as a child in Europe, she developed a simple box-shaped stove with two potholes and a chimney. She had a local mason build the first stoves to her specifications, using adobe and mud mortar as material and making the cooking surface low, to suit local cooking habits.

She convinced some women friends in the town to try out the new stoves and they liked them. Not only did the stoves eliminate the smoke, they also saved firewood, allowed for more stable cooking and provided a raised surface to prepare food and place condiments. Soon the word spread: the stoves became popular in town and in the surrounding villages. The mason could hardly keep up with the orders for "a stove from Mademoiselle." The volunteer began to charge a fee to cover materials and construction costs. This became especially important after she and the mason decided to substitute fired bricks, mortar and concrete for the adobe, in order to make stronger and more durable stoves.

When the volunteer's term was up, one of the foreign aid agencies offered to expand her work into a nationwide stove promotion and dissemination program. She moved to the capital, where a stove demonstration center was built. Publicity campaigns were started in the newspaper and on radio. A local artist designed a stove T-shirt. Three or four standard models were on display at the stove center and could be ordered from a young woman hired to run the stoves for demonstration. A team of masons then came to the customer's home and built the model she had chosen in her kitchen, with instructions of how to properly cure the concrete stove top. Customers were mainly the wives of merchants and government officials. The stoves were becoming a sought-after status symbol in the capital city.

Plans for dissemination included creating more stove centers in other major towns throughout the country. Each would have its own mason team, trained in the capital, to build stoves locally. Radio promotion and word-of-mouth were counted on to create a demand for stoves.

Unfortunately, many of the stoves cracked badly in spite of the improved materials. Users were often impatient and did not let their concrete stoves cure long enough. If a stove broke down, it was sufficient to call the stove demonstration center, and a mason would be sent to repair the stove.

To date, the program is a success. There is a three-week waiting list to have a stove built, and orders are still coming in.

STOVE INTRODUCTION AND DISSEMINATION: CASE STUDY 2

In one Sahelian country, stove developers and local people designed a cookstove together. Local awareness of the firewood crisis was high, due to a Peace Corps energy survey which had recently been taken in the village. The villagers talked to the stove developers of their methods for conserving wood: windbreaks, lids on pots, putting out embers with sand, etc. Then they all talked of reducing heat loss during cooking, using the analogy of light lost from a lantern. Together they decided that putting walls around the fire would be a great improvement. There remained a question of materials: what should this wall be made out of? At this point, the stove developers showed the villagers some dried Lorena, and it was decided that this material might be suitable. Together with the local people, a stove was designed: the cooking pot would be surrounded by Lorena walls, and there would be an entrance on one side for feeding wood into the fire. A space all around the pot would allow the smoke to escape.

The result was a very simple chimneyless one-hole stove. This stove came to play a key role in the national stove dissemination program, especially for regions where one-pot cooking is common. The stated aim of the national program is to saturate the country with stoves by training as many different groups and individuals as possible in stove construction. Workshops are being held all over the country, either by an itinerant mason team or by volunteers stationed in out-lying areas. Local social service organizations are also involved in the training effort. It is hoped that trainees will either become trainers of others, or stove masons who will construct stoves for pay.

Here is an example of how this dissemination effort has worked: a Peace Corps Volunteer taught several women in his village how to build stoves. When he returned after a fortnight away from his village, he found that over a hundred stoves had been built in his absence. Half of them had been built by the women he had trained; the other half by women whom his trainees had taught. The stoves look like volcanoes, rather than model stoves, but they save wood and direct smoke away from the eyes towards the ceiling of the hut. Even though many of the firebox bridges crack and some cave in (partly due to construction flaws and partly due to wear-and-tear), cooks continue to use them and are enthusiastic about their stoves.

EXPLAINING COMPLETED COOKSTOVES

Total time: 1 hour

Objectives:
* To present and explain completed cookstoves
* To discuss the design and construction process for each stove
* To assess the stove training to date

Materials: Completed cookstoves, discussion questions

Trainer Notes

This session requires some preparation. Clearly print the discussion questions on newsprint (see Trainer Notes, Step 2).

Procedures: Step 1. (5 minutes)
Review the session objectives and outline the activities.

Trainer Notes

Explain that in this session, participants will form their original stove construction groups to present and explain the completed stoves to the other groups and discuss the construction and design process.

Step 2. (5 minutes)
Post and explain the discussion questions.

Trainer Notes

Discussion questions include:

* What were the design criteria for the stove?
* What successes and difficulties were encountered during construction?
* Did the work group develop any tools or techniques?
* If so, were they applied successfully?
* What were the dynamics within the work group?
* Was there cooperation and were skills shared?

Explain that each group should respond to the above questions when explaining their stoves.

Step 3. (40 minutes)
Have each group present their stove and discuss how it was designed and constructed.

Trainer Notes

Divide the time allotted for this step evenly among the groups.

Step 4. (10 minutes)
Reconvene the group and have them briefly assess the stove training to date, making suggestions for improvement.

Trainer Notes

Consider the suggestions given by the group in planning and preparing for the remaining sessions, especially before building the second stove.

EVALUATING COOKSTOVE EFFICIENCY

Total time: 2 hours

Objectives:

* To design a methodology for testing wood consumption in a cookstove
* To evaluate wood consumption in a cookstove
* To identify and discuss rules and variables that influence the evaluation procedure
* To discuss the major points of a survey

Resources:

* Evans and Boutette, Lorena Stoves, pp. 84-106
* Aprovecho Institute, Guidelines for Evaluating the Fuel Consumption of Improved Cookstoves
* Aprovecho Institute, Helping People in Poor Countries, pp. 86-95
* Dutt, Field Evaluation of Wood Stoves
* Friesan, "Papers on Cooking Simulation Tests"

Materials: Cookstoves, fuel, pots, water, thermometers, newsprint and felt-tip pens

Procedures:

Step 1. (5 minutes)
Review the session objectives and outline the activities.

Trainer Notes

Mention the following points during the introduction:

* As PCVs, you may find yourselves in a region in which stoves have already been introduced.
* Your job may involve more follow-up and evaluation of different designs than the promotion of stoves.
* Design modifications of existing stoves can be identified through testing and evaluation.

Step 2. (5 minutes)
Explain the procedures to be followed in evaluating and testing the amount of wood used by cookstoves.

Trainer Notes

Have the participants form small groups to design and use a method for testing and evaluating the amount of wood necessary to boil water on their cookstoves.

Ask each group to record general rules and specific variables during their tests.

Mention that they will have 50 minutes to design and carry out their evaluations.

Refer them to Lorena Stoves, pages 88-89, for background information.

Step 3. (50 minutes)
Have the participants form small groups and design and carry out their tests and evaluations.

Step 4. (25 minutes)
Reconvene the groups and discuss the general rules and specific variables that they recorded.

Trainer Notes

Have participants name and discuss the rules and variables that they noted. Record these responses on newsprint in two columns, one entitled, "Rules," and the other, "Variables." The following lists include some of the responses that should be discussed:

Rules

* Define objective
* Establish realistic, representative cooking conditions
* Change only one variable during tests
* Repeat each test using the same stove operator

Variables

* Temperature and quantity of water
* Weather conditions
* Altitude
* Wood (type, moisture content, size, rate of burning)
* Stove operator
* Type and size of cooking vessels (clay, aluminum, iron, with/without lids)

... list of variables, see Helping People in ...

... is often the most significant

...thering reliable data for ...okstoves.

Continued

Trainer Notes/Continued

Ask the group about data interpretation:

How do you use data to optimize design of cookstoves within the limits of local cooking customs?

The ideal would be to use the results of the consumption tests to design a stove that will bring water to a boil quickly in one pot and allow a second pot to simmer.

Step 5. (20 minutes)
Have participants identify and discuss criteria, other than wood consumption, that could be used to evaluate a stove.

Trainer Notes

List the participants' responses on newsprint. If necessary, stimulate the discussion by suggesting such criteria as: health, hygiene, convenience, suitability to local cooking needs, etc.

Explain that the most widely accepted method for testing and evaluating these other criteria is through the use of a "survey."

Step 6. (10 minutes)
Have the participants identify and discuss the major points of an effective survey.

Trainer Notes

Major points of a survey include:

* An unbiased sample
* A large sample
* An accurate recording of observations

Refer participants to Dutt, Field Evaluation of Cookstoves, for further information.

Step 7. (5 minutes)
Conclude the session by having a participant summarize the major points that were discussed.

Trainer Notes

Ask him/her to comment on the kinds of information one could expect to obtain through surveys, cooking simulation tests and actual field measurements.

DIAGNOSING AND REPAIRING MALFUNCTIONING COOKSTOVES
PART ONE: DIAGNOSIS

Total time: 1 hour

Objectives:
* To diagnose problems with malfunctioning stoves
* To discuss cultural values which influence diagnosis and repair of malfunctioning stoves

Resources:
* Attachment II-17/1, "Cookstove Role-Play Situations"
* Evans and Boutette, Lorena Stoves, pp. 74-75

Materials: Malfunctioning cookstoves, fuel, pots for cooking

Trainer Notes

This session requires preparation. You will need several malfunctioning stoves. If necessary, sabotage the stoves so that each has a different problem, i.e., a fallen firebox bridge, cracks, poor draft, poorly fitting potholes, a clogged chimney or tunnel, etc.

Before the session begins, select three volunteers from among the participants to take part in the role-play. The role-players should consist of a woman villager and a visiting man-woman team of development workers involved in a cookstove program.

Brief the "Village Woman" apart from the "Development Workers" to promote more spontaneous and genuine responses from the role-players. Distribute Part A of the Attachment II-17/1 to the "Village Woman" and Part B to the "Development Workers." The role-players should be prepared before the session begins.

Procedures: Step 1. (5 minutes)
Review the session objectives and explain the activities.

Trainer Notes

Explain that this is a two-part session: Part One will deal with diagnosing problems with cookstoves, and Part Two will deal with repairing them.

When you mention the role-play activity, ask that participants watch for behaviors among the role-players that reflect cultural values.

Step 2. (15 minutes)
Have the volunteers perform the role-play.

Step 3. (15 minutes)
Have participants discuss the role-play.

Trainer Notes

To stimulate discussion, ask the following questions:

* How did the role-players feel during their performances?

* What did you notice during the role-play that might have reflected the development workers' cultural values? The villagers cultural values?

* What issues were brought out regarding diagnosis and repair of malfunctioning stoves?

Step 4. (20 minutes)
Guide the participants to each of the malfunctioning stoves and have them diagnose the problem with each.

Trainer Notes

* Have the participants suggest ways to repair each stove.

* It may be necessary to start fires in some of the stoves to diagnose the problems.

COOKSTOVE ROLE-PLAY SITUATIONS

Part A: The Village Woman

You are the woman-of-the-house in a small rural village. About six months ago, a team of development workers from the Ministry of Community Development convinced you that you needed an improved cookstove. They built the stove and briefly showed you how to use it.

You used the stove successfully for a few weeks when it ceased to function properly. You were unable to find out why, so you returned to cooking on an open fire.

You had heard from a village official that a new development team was in the area, and that they might be able to repair the stove. You have invited them to stop by your house.

When they arrive, you will be cooking on an open fire next to your non-functioning sand/clay cookstove. To make the role-play more realistic, you are encouraged to improvise a costume and, if possible, be preparing a hot beverage for your visitors.

------------------- Cut here for distribution -------------------

Part B: The Development Team

You are a female health worker and a male technical stove worker assigned to the Ministry of Community Development. You have recently arrived in-country and have just begun your field assignment. This is your first visit to a village and you are very eager to make a favorable impression.

You have been asked by one of the village officials to visit the house of one of the village women to examine her improved cookstove that is not functioning properly. You have been told by the official that the stove was built about six months ago by another team of development workers.

DIAGNOSING AND REPAIRING MALFUNCTIONING COOKSTOVES PART TWO: REPAIR

Total time: 1 hour

Objective: To repair malfunctioning cookstoves and/or improve existing ones

Resources: Evans and Boutette, Lorena Stoves, pp. 74-75

Materials: Damaged or poorly constructed stoves, sand/clay mix, water, spoons, machetes

Procedures: Step 1. (55 minutes)
Have the participants form work groups and repair or improve a malfunctioning or poorly constructed stove.

Trainer Notes

* Assign each work group one of the malfunctioning stoves.
* Circulate among the groups and assist them by pointing out specific problems and methods for repairing them.
* Mention the importance of improving stoves through better baffles, different kinds of dampers, better firebox sizes and shapes, etc.

Step 2. (5 minutes)
Reconvene the groups and have them read pages 74 and 75 of Lorena Stoves before the end of the session.

Step 3. (40 minutes)
Demonstrate and discuss how the retained heat (haybox) cooker works.

Trainer Notes

Begin by bringing a pot of beans or soup to a boil. With the lid on, put the pot into the haybox. Do not open it until the food is cooked (about one hour and 15 minutes for rice or three hours for beans).

Encourage the participants to examine and ask questions about the cooker.

Stimulate discussion by asking the following questions:

* How does the retained heat cooker work?
* What heat retention principles does it employ?
* What are the fuel-saving advantages of the cooker?

Points to cover when explaining the haybox cooker include:

* Stop the air flow (convection) with a lid on the pot and with a tightly enclosed box, bag or basket.

* Stop conduction and radiation with insulation (straw, sawdust, feathers, etc.) packed tightly around the pot. Approximately four inches of most insulating materials will be sufficient. Stress the use of locally available insulating materials.

* The haybox does not work for small amounts of food. There must be sufficient mass of food for it to store enough heat to work properly.

* The haybox does not work well at high altitudes. The initial temperature of boiling water at high altitudes is not enough to store adequate heat.

* The foods for which the haybox is most suitable include those needing long, slow cooking periods (such as beans, grains, root vegetables, tough meats, stews, soups, long-cooking sauces, etc.).

Step 4. (5 minutes)
Have a participant summarize the advantages of a retained heat (haybox) cooker.

Trainer Notes

Mention that a cooker can be an effective first step, alternative or complement to introducing cookstoves to a village and that it can serve to establish the credibility of a development worker.

OTHER RESPONSES TO FUEL SCARCITY

Total time: 1 hour

Objectives:

* To identify and discuss possible responses to fuel scarcity in the developing world (other than fuel-saving cookstoves)
* To discuss and examine a retained heat (haybox) cooker

Resources:

* Aprovecho Institute, Helping People in Poor Countries, pp. 98-100
* Aprovecho Institute, Retained Heat Cooking

Materials: Two retained heat (haybox) cookers, basket or box with lids, hay or other insulation material, cookpot with lid, soup, rice, beans or stew, newsprint and felt-tip pens

Trainer Notes

In this session, the retained heat or haybox cooker will be demonstrated. You will need to prepare a pot of food to be cooked in the haybox. (For more information, see Helping People in Poor Countries, pages 98 - 100.)

Procedures:

Step 1. (5 minutes)
Review the session objectives and outline the activities.

Step 2. (10 minutes)
Have the participants identify and discuss possible responses to fuel scarcity in the developing world (other than fuel-saving cookstoves).

Trainer Notes

* List the responses on newsprint.
* Some possible responses include: reforestation, solar energy, biogas, retained heat cookers, kerosene, charcoal, etc. (See Phase I: Session 14, "Global Energy Issues," for more information.)
* Explain that this session will focus on one of these responses: the retained heat or haybox cooker.

CHARCOAL PRODUCTION AND STOVES

Total time: 1 hour

Objectives:

* To discuss how charcoal is produced
* To identify and discuss advantages and disadvantages of charcoal as a fuel
* To discuss ways in which traditional charcoal cookstoves could be improved

Resource: Aprovecho Institute, Helping People in Poor Countries, pp. 132-137

Materials: Wood for fuel, retort (see Trainer Note, Step 4), examples of traditional charcoal cookstoves, newsprint and felt-tip pens or chalkboard/chalk

Trainer Notes

This session will require preparation of a charcoal retort. You will also need to have an operating charcoal stove for demonstration purposes (see Trainer Notes, Step 2).

Procedures:

Step 1. (5 minutes)
Review the session objectives and outline the activities.

Step 2. (10 minutes)
Have the participants identify and discuss the characteristics of a charcoal fire, as compared with a wood fire.

Trainer Notes

Ask the participants if they have ever cooked on a charcoal fire and if they noticed how it burned differently from a wood fire. List their responses on newsprint, and encourage questions and discussions.

If they are not identified by the group, add the following characteristics to the list:

* Little flame
* More even heat
* Mostly radiant heat (pots need to be closer)
* Few hot gases (not suitable for stoves with tunnels)
* Needs more evenly distributed air (burns best on 25% - 35% grate)

For demonstration purposes, it is best to have a functioning charcoal stove on hand during the discussion.

Step 3. (10 minutes)
Briefly explain how charcoal is produced.

Trainer Notes

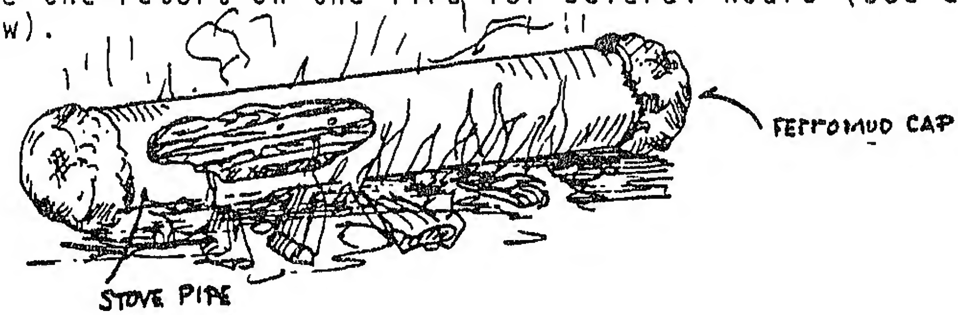
Describe the earthen mound system, external fire charcoal retorts and internal fire charcoal kilns. Discuss efficiencies of each type (wood in - charcoal out) and the energy content of charcoal and wood.

Step 4. (Optional, 10 minutes)
Have the group begin the charcoal-making process by loading and firing a retort.

Trainer Notes

To make a simple retort:

* Using a 60cm (2') section of stove pipe, load it tightly with wood, being careful to allow some air space.
* Cap the ends of the stove with ferromud (fine mesh wire plastered with a clay/sand mixture).
* Set the retort over an open fire.
* Periodically check the ends for air leaks.
* Leave the retort on the fire for several hours (see drawing below).



Step 5. (15 minutes)
Have the participants identify and discuss the advantages and disadvantages of charcoal as a fuel.

Trainer Notes

List the advantages and disadvantages in separate columns on newsprint. Add the following points to the list, if they are not identified by the participants:

Continued

Trainer Notes/Continued

Advantages

* Low smoke
* Light weight for transport
* Less volume (easy to store, especially in cities)
* Used with low cost and portable stoves
* Easy to see
* Stores well for a long period at a constant moisture content
* Provides employment

Disadvantages

* Increased deforestation due to poor conversion rate (out of total wood burned for charcoal, there is a 65 - 80% energy loss)
* Gives off poisonous fumes
* Dirty
* Carbon dust is health hazard

Explain that although charcoal causes more rapid deforestation, the demand for charcoal will continue. There will continue to be a demand for it as a fuel source in the cities. The need exists to develop more efficient charcoal production techniques and charcoal stoves.

Step 6. (15 minutes)
Present examples of traditional charcoal cookstoves and discuss ways in which they could be made more fuel-efficient.

Trainer Notes

Suggest the following improvements:

* Insulate around the stove and under the grate area (leaving sufficient draft).
* Install a damper.
* Construct a ferromud chimney around the pot.
* Recess the pot deeper into the stove.

Step 7. (5 minutes)
Conclude by reviewing the objectives.

Trainer Notes

Explain that everyone will have the option of building a charcoal cookstove in the second stove construction session, Phase II: Session 21.

Encourage participants going to urban areas or countries in which charcoal is common to build charcoal stoves in Session 21.

CUSTOM AND FOOD

Total time: 2 hours

Objectives:

* To discuss the role that custom and belief play in determining diets in the United States and in developing countries
* To develop a sample, low-cost, nutritious diet using specific cultural guidelines

Resources:

* Werner, Where There Is No Doctor, pp. 1-17
* Brownlee, Community, Culture & Care, pp. 173-213
* Jelliffe, Child Nutrition in Developing Countries, Chapter IV
* Katz, Food, Where Nutrition, Politics and Culture Meet, pp. 8-10
* Attachment II-20, "Planning a Low-Budget, Nutritious and Culturally Appropriate Diet"

Materials: Newsprint and felt-tip pens, notebooks, pencils or pens

Trainer Notes

Prepare copies of the Jelliffe and Katz resources for distribution during the session.

Procedures:

Step 1. (5 minutes)
Review the session objectives and activities.

Step 2. (55 minutes)
Distribute copies of the Jelliffe and Katz resource materials and have the participants read them.

Step 3. (15 minutes)
Have the participants identify the main points covered in the readings and briefly discuss them

Step 4. (10 minutes)
Have the participants list (in their notebooks) and categorize ten of their favorite childhood foods and ten of their currently favorite foods.

Trainer Notes

Have participants associate each food with the categories described in the Jelliffe material (pages 62-64), i.e., cultural super, prestige, body image, physiological, sympathetic magic group.

Ask why such foods have been or are favorites and encourage comments and questions.

Explain that participants should keep their food lists in their notebooks for use in Phase II: Session 23.

Step 5. (10 minutes)
Have the participants list and categorize ten foods that are "typical" in the countries in which they will be serving as Peace Corps Volunteers

Trainer Notes

Use the same categories from the Jelliffe book and ask the participants to save the lists for use in Phase II: Session 23.

Step 6. (10 minutes)
Distribute, review and explain Attachment II-20, "Planning a Low-Budget, Nutritious and Culturally Appropriate Diet."

Trainer Notes

Attachment II-20 contains an on-going assignment that is to be worked on throughout the program and completed in Phase V.

Explain that:

* The participants have the option of forming small groups to work cooperatively on the assignment.

* The completion of the assignment will require additional information that will be covered in Phase II: Session 23, "Basic Nutrition."

* The assignment will be due and discussed duri
Session 14, "Planning a Nutritional Garden."

Step 7. (15 minutes)
Have the participants begin workir
assignments.

PLANNING A LOW-BUDGET, NUTRITIOUS AND CULTURALLY APPROPRIATE DIET

The following foods and their prices are typical of the diet in the Ecuadorian highland region. Plan a day's menu that provides sufficient protein, fats, vitamins, minerals and caloric requirements, and falls within the guidelines of available time for preparation and economic and cultural constraints.

* There are six people in the family, including four children (ages 1 to 12).

* Corn products are usually available and need not be purchased.

* There is a scarcity of quinoa, a high-protein grain, and it is available only in limited quantities.

* Fava beans must be purchased, since the crop has failed this year.

* You have the equivalent of one dollar to spend for the day's meals.

* Milk and cheese are available only in the city (an hour's walk away, or a 12-cent bus ride) and meat is sometimes available only in the city.

* Wild greens are in limited supply, since the rains have not been constant.

* There is squash available in the fields, but only in limited quantity.

* The woman in the family suffers from "white discharge" and will not eat milk products, squash or pork because it may make her condition worse.

* Two of the under-five children have diarrhea and will not be allowed to eat "cold" foods: squash, pork, oranges, papaya.

* Guinea pig (cuy) is used for festive occasions (as is any other meat product, except for fat/lard).

* The family has an income of approximately $60 (U.S. of which $20 must be spent on the children's educa books, uniforms, fees, etc.

* The rains have not come and grasses (at about 4 must be purchased for the guinea pigs each day s no other food.

* There are a few vegetables in the family garden, from a previous Peace Corps project, but they ar rapidly from the lack of water and care.

* Firewood must be brought down from the mountain (where the hacienda owner has his land), a job requiring two days. In addition, the family must pay with labor for the wood carried out.

* The husband must be taken his lunch. He works at a construction site temporarily, in a city nearby which is accessible by walking or by bus.

* Water comes from the community tap, but the nearest one is not working, so a trip must be made down into the village.

* There is a fiesta to be held this weekend at the house of relatives. The family is expected to bring food and drink, so money must be put aside to buy extra potatoes, lard, beans and a bottle of trago.

* The woman's breast milk is drying up, and the one-year-old is losing weight.

* One of the children is expelling worms when he defecates. The mother restricts his intake of milk and other "cold" foods until the worms are gone.

* Money must be kept aside for cooperative dues (20 cents per month).

* The bean water (from cooking beans) cannot be used, due to the woman's illness (the white discharge).

* The family is afraid of extremely "cold" foods, especially in the early morning or at night. Such foods are: cabbage, pork, squash, oranges, and any leftovers that have not been boiled.

* The biggest meal is at mid-day and must include beans, corn, soup (with a corn or oatmeal base or a broth with potatoes and suet), and potatoes.

* There are two other meals: early morning, where herb tea and sugar are drunk with a piece of bread or toasted corn or leftover soup; and the evening meal, where soup or leftovers from lunch are served.

Foods and Prices

Beans: 20 to 40 cents per lb. (Some may be available from crops.)
Lentils: 30 cents per lb.
Fava beans: about 40 cents per lb.
Quinoa: 30 cents per lb.
Cuy: 4 dollars per animal
Meat:one dollar per lb.
Suet (fat from meat): 50 cents per 1/2 lb.
Lard: 75 cents per 1/2 lb.
Vegetable shortening: 75 cents per lb.
Oil: 1.20 per liter
Bananas: 2 cents each
Oranges: 2 cents each
Onions (scallion-type): 12 cents for 5-6 onions
Rice: 30 cents per lb.
Lettuce: 20 cents per head
Cabbage: 30 cents per head
Watercress, other greens: 4 cents per bunch
Tomatoes: 7 cents each
Chili peppers: 4 cents for 5-6 peppers
Chicken: one dollar per lb. (only in 3-4 lb. quantities)
Potatoes: 12 cents per lb.
Milk: 25 cents per liter
Cheese: one dollar per lb.
Raw sugar: 10 cents per block (2 cups, more or less)
White sugar: 25 cents per lb.
Herbs: 1-4 cents per bunch
Papaya: 30 cents each
Canned tuna: one dollar per can
Noodles: 50 cents per lb.
Bread: 2 cents per loaf
Eggs: 10 cents each
Butter: one dollar per lb.
Spices: 4 cents per oz.
Soft drinks: 15 cents
Liquor (*trago*): one dollar per bottle

* * *

After completing the exercise, take time to discuss, in writing, the following:

1. Name several economic constraints that limited the amounts or types of foods purchased.
2. Name several social/cultural considerations you followed in planning the diet.
3. What was the most difficult aspect of the planning (i.e., the economics, cultural factors, availability or scarcity of foods, etc.)?
4. Which major nutrients are included (in proper amounts) in the diet? Which are lacking?
5. Do you think that a rural family can eat nutritious meals based on the information included in this exercise? Explain.
6. What would you add or delete from the exercise?

Foods and Prices

Beans: 20 to 40 cents per lb. (Some may be available from crops.)
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3. What was the most difficult aspect of the planning (i.e., the economics, cultural factors, availability or scarcity of foods, etc.)?
4. Which major nutrients are included (in proper amounts) in the diet? Which are lacking?
5. Do you think that a rural family can eat nutritious meals based on the information included in this exercise? Explain.
6. What would you add or delete from the exercise?

DESIGN AND CONSTRUCTION OF THE SECOND STOVE
PART ONE: STOVE BASE

Total time: 1 hour

Objectives:
* To design and construct a second, improved cookstove
* To lay out and build the base for the second, improved cookstove

Resources:
* Aprovecho Institute, Helping People in Poor Countries, pp. 111-144
* Evans and Boutette, Lorena Stoves

Materials: Clay, sand, rubble, water, earthen blocks, bricks, soil cement blocks, rocks, mortar, sifters, shovels, hoes, machetes, trowels

Trainer Notes

The format for building stoves a second time may vary, according to the training program. Depending upon the needs of the participants and the time available in the program, the following options can be exercised:

* The second stove may be completely built anew, beginning with the base construction, including new clay and sand for mixing.
* After removing the clay/sand mass, the second stove may be built from the original base or floor, using the same mix or mixing anew, emphasizing speed, finish and care.
* A second stove may be designed but not built.

At least one of the original stoves should be left for use during the Health and Nutrition sessions.

Procedures:

Step 1. (5 minutes)
Explain the session objectives and review the activities.

Step 2. (5 minutes)
Discuss and clarify the second stove construction options.

Trainer Notes

xplain that constructing a second, improved cookstove is an pportunity for independent work and the application of stove rinciples learned to date.

xplain that the participants may select a stove design appro-riate to the country in which they will be serving.

uggest the following improved charcoal stove designs for those articipants who will be going to urban areas or countries in hich charcoal use is common:

- The Voltena stove
- The Singer stove
- Sand/clay (Lorena) charcoal stove
- Portable metal charcoal stoves (the improved Tiki, for example)

articipants may also choose to work on improving the designs f existing charcoal stoves. Additional designs (and details the stoves listed above) can be found in Helping People in oor Countries, pages 111-144.

ention that since sheetmetal stove pipes may be expensive or navailable, stove pipes should be built from alternative aterials such as Lorena blocks, ferromud, bamboo, clay tiles, tc. (Refer the participants to pages 66-68 in Lorena Stoves or more information.)

xplain that the work groups building cookstoves with chimneys ill be asked to give a presentation on chimneys during the tove tours (see Phase II: Session 22) and should pay special ttention to the previously-cited reference.

Step 3. (50 minutes)
Have the participants form their work groups, design their stoves and lay out their stove bases.

Trainer Notes

e procedure here is the same as described in Phase II: ession 10, Part 1.

;IGN AND CONSTRUCTION OF THE SECOND STOVE
ꝛT TWO: STOVE MASS

:al time: 3 hours

ectives:

* To design and construct a second, improved cookstove
* To build the mass for the second cookstove
* To use stove construction skills

ources:

* Aprovecho Institute, Helping People in Poor Countries, pp. 111-144
* Evans and Boutette, Lorena Stoves, pp. 50-57 and 66-68

erials: Clay, sand, water, sifter, machete, trowels, shovels, hoes

cedures:

Step 1. (5 minutes)
Review the session objectives and outline the activities.

Step 2. (2 hours, 55 minutes)
Have the participants form construction groups and construct the stove masses.

Trainer Notes

Details on the construction of the stove mass can be found in Phase II: Session 10, Part 2.

Encourage the participants to experiment with alternative chimneys. (Refer them to Lorena Stoves, pages 66-68.)

DESIGN AND CONSTRUCTION OF THE SECOND STOVE
PART THREE: EXCAVATION AND FINISHING

Total time: 2 hours

Objectives:

* To design and construct a second, improved cookstove
* To excavate and finish the cookstove
* To construct an alternative chimney for the cookstove

Resources:

* Aprovecho Institute, Helping People in Poor Countries, pp. 111-144
* Evans and Boutette, Lorena Stoves, pp. 58-69

Materials: Clay, sand, water, machete, trowels, spoons, shovels, hoes, bamboo, sheetmetal, wood (for dampers, baffles), nails, hammers

Procedures:

Step 1. (5 minutes)
Present the session objectives and outline the activities.

Step 2. (1 hour, 55 minutes)
Have the construction groups excavate and finish their second, improved cookstove.

Trainer Notes

The procedure for the excavation of the stove mass can be found in Phase II: Session 10, Part 3 and in Lorena Stoves, pages 58-69.

Assist the groups in:

* Excavating pot holes, tunnels and chimney holes
* Cutting dampers
* Finishing the stoves

Encourage the groups to apply a protective coating to the stoves (refer to Lorena Stoves, pages 58-69, for details).

Stress the importance of using alternative materials for construction of chimneys (See Part One).

SIGNS OF NUTRITIONAL STATUS

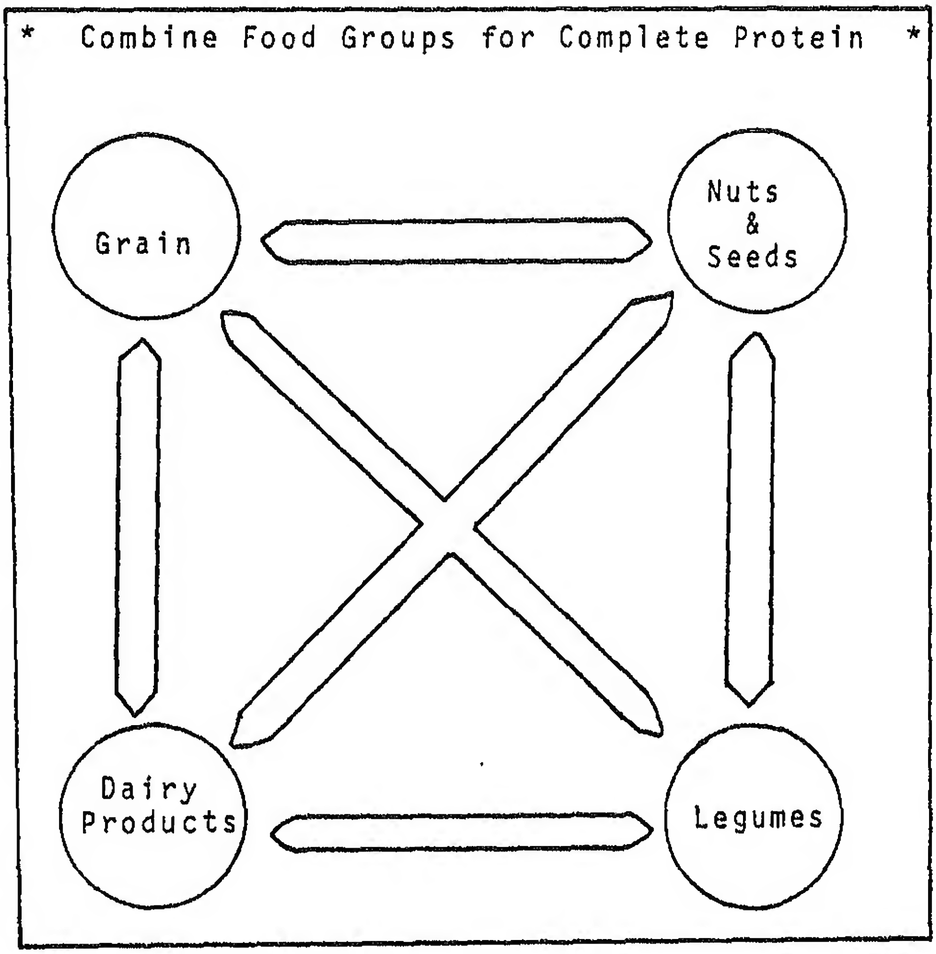
	GOOD	POOR
General appearance	Alert, responsive	Listless, apathetic
Hair	Shiny, lustrous, healthy scalp	Stringy, dull, brittle, dry, depigmented
Neck (gland)	No enlargement	Thyroid enlarged
Skin (face & neck)	Smooth, slightly moist, good color, reddish-pink mucous membrane	Greasy, discolored, scaly
Eyes	Bright, clear, no fatigue	Dryness, signs of infection, increased vascularity, glassiness, thickened conjunctiva
Lips	Good color, moist	Dry, scaly, swollen, angular lesions (stomatitis)
Tongue	Good pink color, surface papillae present, no lesions	Papillary atrophy, smooth appearance, swollen, red, beefy (glassitis)
Gums	Good pink color, no swelling or bleeding, firm	Marginal redness or swelling, receding, spongy
Teeth	Straight, no crowding, well-shaped jaw, clean, no discoloration	Unfilled caries, absent teeth, worn surfaces, mottled, malposition
Skin (general)	Smooth, slightly moist, good color	Rough, dry, scaly, pale, pigmented, irritated, petachia, bruises
Abdomen	Flat	Swollen
Legs, feet	No tenderness, weakness, or swelling, good color	Edema, tender calf, tingling, weakness
Skeleton	No malformations	Bowlegs, knock knees, chest deformity at diaphragm, beaded ribs, prominent scapulae

THE FOOD SQUARE

ENERGY FOODS Staple Foods Examples: Cereals and grains (Wheat, rice, maize, sorghum, millet, etc.) Starchy roots (Cassava, potatoes, etc.) Starchy fruits (Banana, breadfruit, etc.) Importance All staple foods are cheap energy sources. Cereals are also cheap sources of protein, iron and the vitamin B-complex.	BODY BUILDING FOODS Protein Supplements Examples: Legumes (Beans, peas, groundnuts*, soya-beans*, etc.) Nuts* (Almonds, walnuts, cashews, hazel nuts, etc.) Oil seeds* (Sesame, sunflower, etc.) Animal products (Milk, meat, fish, eggs, insects, etc.) Importance Combined with staples, these foods increase the quantity and improve the quality of the protein in the meal. * Also valuable as an energy supplement, due to their high fat content.
PROTECTIVE FOODS Vitamin and Mineral Supplements Examples: Vegetables (Dark green leafy vegetables, kale, leek, carrots, turnips, tomatoes, peppers, etc.) Fruits (Mango, orange, papaya, etc.) Importance Provide vitamins A and C to the diet. Dark green leafy vegetables are also excellent sources of iron and the vitamin B complex.	ENERGY STORAGE FOODS Energy Supplements Examples: Pure fats (Oils, butter, ghee, lard, etc.) Fat-rich foods (Nuts, oil-seeds, bacon, fatty meat, etc.) Pure carbohydrates (Sugar, honey, jaggery, etc.) Importance These foods are low-bulk concentrated energy sources. Fat contains twice as much energy as carbohydrate.

Adapted from Lillemor Abrahamson and Nancy Velarde, "Food Classification for Developing Countries, page 117, Teaching Nutrition in Developing Countries, edited by Kathryn Shack, 1977, N. Y., Meals for Millions Foundation.

PLANT PROTEIN COMPLEMENTARITY



Adapted from page 124, Diet for a Small Planet, by Frances Moore Lappe, 1971, N. Y., Ballantine Books.

DAILY DIETARY GUIDELINES

Note: These guidelines are not designed for pregnant or lactating women or young people under the age of four years. Check current resources.

All Plant Diet

1-1/4	serving legumes or 1/3 serving legumes + 2 servings soymilk
3-5	servings whole grains (2 grains + slices bread)
1	serving nuts and/or seeds (sesame for calcium)
4	servings vegetables (2 dark leafy green)
1-4	servings fruits (1 raw citrus)
1-2	tablespoons nutritional yeast (B12 + B vitamins)
5-30	minutes skin exposure to sunlight for Vitamin D
1+	tablespoon polyunsaturated vegetable oil (linoleic acid)

Plant and Dairy Diet

1	serving legumes
4	servings whole grains
1	serving nuts and/or seeds
3	servings vegetables (1+ dark leafy green)
1-4	servings fruits (1 raw citrus)
2	servings dairy (3+ for the young)
5-30	minutes skin exposure to sunlight for Vitamin D
1+	tablespoon polyunsaturated vegetable oil (linoleic acid)

Animal Meat/Dairy and Plant Diet

2+	servings lean meat, poultry or fish
4	servings grains
4	servings vegetables & fruits (2 dark green/1 raw citrus)
2-4	servings dairy (eggs, up to 4 per week)
5-30	minutes skin exposure to sunlight for Vitamin D

Key

1 serving = 1 cup; 100 grams; 8 ounces liquid; 1/2 cup cooked cereal, rice or noodles; 1/2 cup raw or cooked vegetable; 1 slice bread; 1 potato or fruit; 4 T. peanut butter; 2 eggs; 2-3 ounces lean meat, fish or poultry; 2 ozs. of cheese; 4 ozs. of tofu.

Sources: Food and Nutrition Board, National Research Council (Revised 1974); Laurel's Kitchen, Robertson, Flinders & Godfrey, 1976, Berkeley, Nilgiri Press; Nutrition and Physical Fitness, Bogert, Boggs & Calloway, 1973, Philadelphia, Saunders.

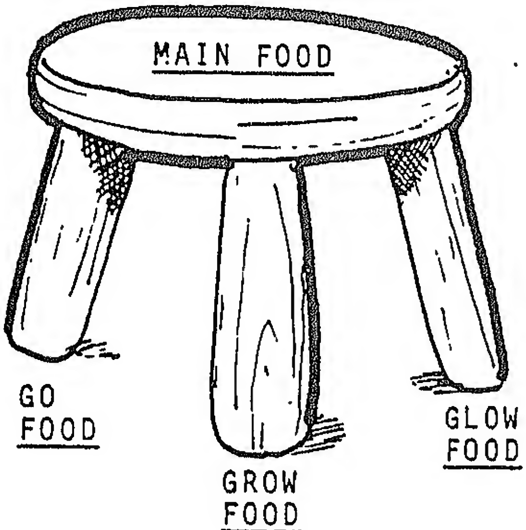
FOUR DAY FOOD DIARY

Keep a careful and accurate diary of the foods you eat over a four-day period. Organize the foods and their servings into categories (see below). Use the Food Square and the Daily Dietary Guidelines to organize your thinking about surveying your diet. Note the key on average servings for your entries.

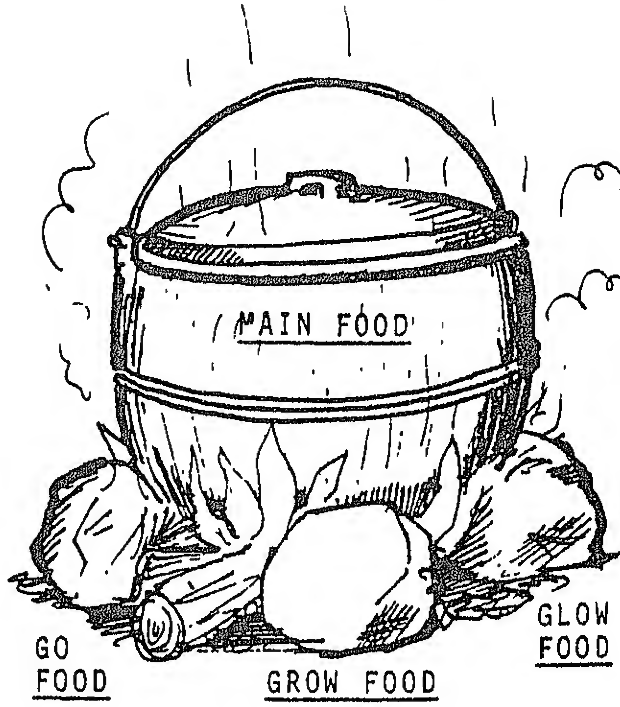
Record the number of servings you have daily in each category:

Food	Day 1	Day 2	Day 3	Day 4	4-Day Total	Average
Legumes Poultry Fish Meat						
Grains						
Dairy Products						
Vegetables (Color code: Dark, leafy greens and yellow/ orange)						
Fruits						
Nuts/Seeds						
Miscellaneous						

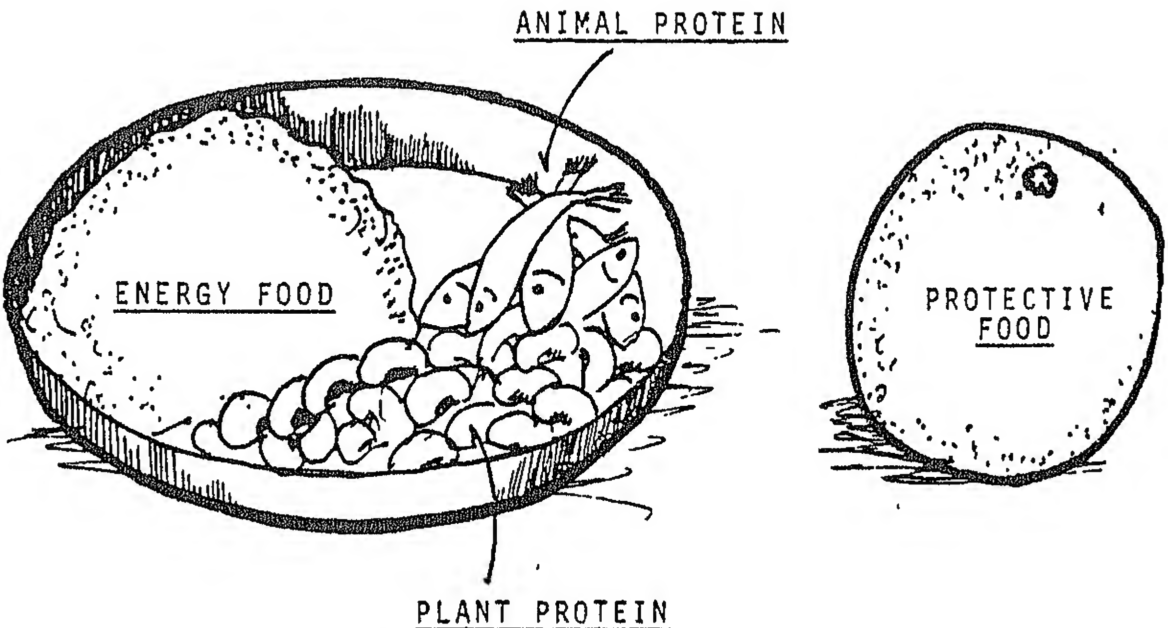
NUTRITION EDUCATION TOOLS



THREE-LEGGED STOOL



THREE ROCK FIRE



A BALANCED MEAL IS A MIXED ONE.

Adapted from Werner and Bower, Helping Health Workers Learn, and King, Nutrition in Developing Countries.

COOKSTOVE OPERATION
PART ONE: COOKING ON SAND/CLAY COOKSTOVES

Total time: 4 hours

Objectives:

* To plan a nutritionally balanced and culturally appropriate meal
* To prepare the meal on a sand/clay cookstove
* To demonstrate the process to others

Resources:

* Jelliffe, Child Nutrition in Developing Countries, pp. 24-41
* Paley, Gardening for Better Nutrition, pp. 26-27
* Robertson, Flinders, Godfrey, Laurel's Kitchen
* Attachment II-24/1, "Evaluation of Cooking Exercise"

Materials: Sand/clay cookstoves (ready for firing), cook kits for each stove (pots, pans, cooking and eating utensils, pot holders), kindling, firewood, machetes, baking soda, water (in case of fire), foods as needed

Trainer Notes

This session will require considerable preparation. You will need to set up food stocks for the cooking activity and devise a food list with the cost of each food item (see Trainer Notes, Step 2). Read the session carefully before beginning.

Procedures:

Step 1. (5 minutes)
Present the session objectives and outline the activities.

Step 2. (15 minutes)
Give a brief talk on tropical foods. Invite comments.

Trainer Notes

Refer to Jelliffe, pages 24-41, for information.

Step 3. (15 minutes)
Give a brief talk on nutrition and cooking, inviting comments and discussion.

Trainer Notes

* Set up a role-play situation in which participants use their food item cost lists to "purchase" foods from staff members acting in the role of local market vendors.

* If a real local market is nearby, have the participants go there to purchase their foods.

* If there is an available garden, the participants should harvest their vegetable and herb needs, rather than purchase them.

Step 7. (1 hour, 20 minutes)
Have the participants prepare their meals using a sand/clay cookstove.

Step 8. (30 minutes)
When the meals are ready, have each group give a cooking demonstration, allowing the other groups to taste the food they have prepared.

Trainer Notes

Explain that each demonstration should:

* Describe how the stove works

* Describe the meal and its nutritional qualities

* Describe how the food was prepared and cooked to maintain nutritional value

Encourage each group to use non-technical language and non-formal education techniques in its demonstration.

Step 9. (20 minutes)
Distribute Attachment II-24/1, "Evaluation of Cooking Exercise," to each group and have them complete it.

Step 10. (15 minutes)
Have participants clean the work site.

Trainer Notes

* Discuss information about the preservation of nutrients in cooking and the benefit of using cast-iron cookware.

* Refer to Laurel's Kitchen, pages 436 and 441-446, and to Paley, pages 26-27, for more information.

Step 4. (10 minutes)
Distribute and explain the food lists and costs to the participants.

Trainer Notes

Select foods that are specific to areas in which participants will be working as Peace Corps Volunteers.

Step 5. (30 minutes)
Have the participants form cooking groups and plan the meals they will be preparing.

Trainer Notes

Explain that this is a good opportunity for participants to practice planning culturally appropriate menus and cooking with foods that are common in the countries in which they will be serving.

To encourage low-cost menu planning, set a cost limit per person.

Have the groups plan their menu activity such that:

* All group members participate in all phases of planning, purchasing, preparing and demonstrating the meal.

* Appropriate technology devices are used and there is not a strong dependence on modern equipment.

* The meal is nutritionally balanced (See Phase II: Session 23, "Basic Nutrition," for more information).

Step 6. (20 minutes)
Have the groups purchase the foods they will need.

EVALUATION OF COOKING EXERCISE

Answer the following questions in your cooking groups. Analyze the group process and the type of food prepared. The answers should be written as a group and given to the trainers.

1. How were the tasks divided? Who did what?

2. Did all group members participate fully? If not, why (what impeded cooperative effort)?

3. What food was cooked? What was the recipe?

4. What was the nutritional value of the food? What nutritional needs did the food satisfy? If there were sources of protein, were they complementary? (Illustrate.)

5. Did the food taste and look appetizing? If not, what could be done to improve flavor and appearance? Would you use this recipe again?

6. What appropriate technology devices were used in the preparation? Were they appropriate for the tasks? How could preparation have been more low-tech or appropriate or more efficient?

7. What would you tell others attempting to do the same job to make it flow more easily or better?

8. Were the devices used for food preparation potentially useful and suitable for application during Peace Corps service? Are they potentially appropriate for use by all members of a community, including women and children? Explain your answers.

9. Did you notice any implications for health during the use of the appropriate technology devices? Please state any observations.

COOKSTOVE OPERATION
PART TWO: EVALUATING COOKSTOVE OPERATION

Total time: 1 hour

Objectives:

* To identify and discuss advantages and disadvantages of cooking with an improved sand/clay cookstove
* To discuss ways to overcome the disadvantages
* To identify and discuss ways to conserve cookstove fuel

Resources:

* Evans and Boutette, Lorena Stoves, pp. 71-72, 74-75
* Jenquier, Appropriate Technology: Problems and Promises, Chapter II, "The Innovative System in Appropriate Technology, pp. 27-40

Materials: Newsprint and felt-tip pens

Procedures:

Step 1. (5 minutes)
Review the session objectives and activities.

Step 2. (20 minutes)
Have the participants identify and discuss a list of advantages and disadvantages of cooking with improved sand/clay cookstoves.

Trainer Notes

Record their responses in two columns on posted newsprint.

Step 3. (15 minutes)
Discuss ways in which each of the disadvantages might be overcome.

Trainer Notes

For those disadvantages which relate to stove malfunctions, refer to pages 74-75 of Lorena Stoves.

Step 4. (15 minutes)
Have the participants identify and discuss ways of conserving the amount of fuel used in the cookstoves.

Trainer Notes

For detailed information regarding the points that should be covered in this discussion, see pages 71-72 in Lorena Stoves.

Step 5. (5 minutes)
Assign Chapter II, "The Innovative System in Appropriate Technology," pages 27-40, from Appropriate Technology: Problems and Promises, and explain that it should be read before the next cookstove session.

Trainer Notes

The next cookstove session (Phase II: Session 25) requires a participant volunteer to facilitate a discussion of the above reading assignment.

Select that participant/facilitator at this time. Review the activities in Session 25 with him/her, paying special attention to the Trainer Notes under Step 2. Give the participant/facilitator a copy of the following questions for discussion:

* What were some of the important issues raised in the reading?

* What does the statement "appropriate technology is community technology" mean?

* How would you go about verifying that your perceptions of a village's needs correspond with the felt needs of villagers?

Explain that these discussion questions should be used as guidelines for the up-coming discussion.

COOKSTOVE DEVELOPMENT AND INNOVATION

Total time: 2 hours

Objectives:
* To identify and discuss issues of cookstove development and innovation
* To discuss past experiences with cookstove development and innovation

Resources:
* Jequier, Appropriate Technology: Problems and Promises, pp. 27-40 (previously assigned reading)
* Evans and Boutette, Lorena Stoves, pp. 120-129

Materials: Newsprint and felt-tip pens or chalkboard/chalk

Trainer Notes

This session requires some preparation. Choose one of the options outlined in Step 3 and plan accordingly. Step 2 of this session is designed to be facilitated by a participant. This participant/facilitator was selected and briefed during the previous cookstove session (See Phase II: Session 24/2, Step 5, Trainer Notes).

Procedures:

Step 1. (5 minutes)
Review the session objectives and outline the activities.

Step 2. (25 minutes)
Have the participant/facilitator guide a discussion of the reading material assigned in Phase II: Session 24/2 (Jenquier, pages 27-40).

Trainer Notes

Some important points that should be covered include:

* The importance of initiating the process of development at the local level
* The participation of villagers in defining their needs vs. the technical experts' perceptions of what the villagers needs are
* The participation of local people as the foundation for building self-confidence and local problem-solving capabilities

Allow time at the end of the discussion for feedback on the facilitation skills of the participant/facilitator.

Step 3. (30 minutes)
Have the participants read pages 120-129 in Lorena Stoves, "A Socio-Cultural Assessment of the Lorena Stove and Its Diffusion in Highland Guatemala."

Trainer Notes

An option to the reading from Lorena Stoves is to examine and discuss Peace Corps stove programs in various countries (i.e., the Philippines, Senegambia, the Dominican Republic, etc.). If you have access to information (case studies, etc.) or first-hand experience of these programs, this would be a good opportunity to share and discuss this information with the participants. It will help increase their understanding of programs in which they might eventually be a part.

If you decide to choose this option, disregard Steps 3-5 and use the remaining 1-1/2 hours to examine and discuss some Peace Corps stove programs.

Step 4. (55 minutes)
Have a participant volunteer facilitate a discussion of the reading material.

Trainer Notes

Explain that the participant/facilitator should use the same questions to guide this discussion that were used to guide the previous one (Phase II: Session 24/2, Step 4, Trainer Notes.

The following points should be raised during the discussion:

* The need to incorporate women, as cookstove users, in the design and construction process (and generally throughout the development process)

* That training of villagers should focus on stove principles and processes so that people can apply them to suit their needs

* That the training of villagers should emphasize stove operation and maintenance as well as design and construction

* That cookstove development programs must include local follow-up for repair, evaluation and dissemination of cookstove design modifications developed on the basis of evaluation

Continued

Trainer Notes/Continued

* That follow-up is essential to the development of stoves that respond to local needs and conserve fuel, and to insure that important technical principles are not forgotten

Allow time at the end of the discussion for feedback on the facilitation skills of the participant/facilitator.

Step 5. (5 minutes)
Conclude by having a participant summarize the key points raised in both discussions.

COOKSTOVE INFORMATION AND RESOURCES/ EVALUATION OF COOKSTOVE TRAINING

Total time: 2 hours

Objectives:
* To identify and discuss resources and information for cookstove projects
* To evaluate the cookstove training
* To clean up the cookstove work area

Resource: Aprovecho Institute, "Cookstove News, Vol. 1, No. 1, 2, 1981,pp. 8-12

Materials: Newsprint and felt-tip pens or chalkboard/chalk

Procedures:

Step 1. (5 minutes)
Review the session objectives and outline the activities.

Step 2. (25 minutes)
Discuss potential sources of information and resources for cookstove projects.

Trainer Notes

Explain that it is important to know how and where to obtain financial, material and technical information and/or resources for cookstove projects.

Mention that in "Cookstove News," Volume I/Number 1, pages 8-12, they will find a list of individuals and organizations currently working in stove programs worldwide. (All issues of "Cookstove News" list information and resources of interest to cookstove programs.)

Stress the importance of exchanging information, ideas and resources with other stove programs.

Step 3. (30 minutes)
Have the participants evaluate the co
training.

Trainer Notes

Choose one of the following options for carrying
evaluation:

Option A:

Ask the participants what they felt was positive abo
training and what suggestions they would have for i

Con

Trainer Notes/Continued

List their responses on newsprint in two columns, one entitled "Positive Aspects," and the other entitled "Suggestions for Improvement." Encourage questions, comments and discussion.

<u>Option B</u>:

Have the participants form small groups. Ask each group to develop a list of "Positive Aspects" and "Suggestions for Improvement." Then have the groups share their lists with each other, discussing and clarifying them with questions and comments.

Step 4. (1 hour)
Have the participants clean up the work area, tools, etc.

PHASE III: PEDAL/TREADLE POWER

Health and Nutrition

The Role of the Volunteer in Development

PHASE III CALENDAR - Page 1

	DAY 1	DAY 2	DAY 3
A.M.	SESSION 1: Maternal and Child Health, Part 1 (Skill Area II) SESSION 2: The Path of the Sun (III)	SESSION 5: Classical Mechanics: Principles of Pedal/ Treadle Power (III) SESSION 6: Use of Appropriate Aids to Communication (IV)	SESSION 9: Introduction to Design (III)
P.M.	SESSION 3: Introduction to Pedal/Treadle Power (I & IV) SESSION 4: Design Considerations for Pedal/ Treadle Devices (I & III)	SESSION 7: Maternal and Child Health, Part 2 (II) SESSION 8: Part 1 - Familiarization with Parts and Tools Part 2-Familiarization with the Bicycle (III)	SESSION 10: Presentation of Designs (IV) SESSION 11: Construction of Pedal/Treadle Devices (III & IV)
	DAY 4	DAY 5	DAY 6
A.M.	Construction (continued)	Construction (continued) SESSION 12: Blacksmithing and Metal Work (IV)	Construction (continued)
P.M.	Construction (continued)	SESSION 13 Appropriate Technologies for Health (II & IV) SESSION 14: Case Studies in Community Health (III)	

	DAY 7	DAY 8	DAY 9
A.M.	Independent Study	SESSION 16: Heat Transfer (III)	SESSION 19: Volunteer in Development, Part 1: Women in Development (I & III)
	Construction (continued)	SESSION 17: Role of the Volunteer in Development: International Development, Part 1: The Green Revolution (II & III)	Independent Study
P.M.	Construction (continued)	SESSION 18: Presentation of Pedal/Treadle Powered Devices (III)	SESSION 20: Mid-Program Evaluation (V)
	SESSION 15: Preparation for Pedal/Treadle Presentations (IV)		

MATERNAL AND CHILD HEALTH: PART 1

Total time: 2 hours

Objectives:

* To identify and discuss signs and conditions of malnutrition and illness

* To discuss reasons for "high risk" health conditions among mothers and children in developing countries

Resources:

* Werner, Where There Is No Doctor, pp. 245-282, 283, 294 and 295-321

* Jelliffe, Child Nutrition in Developing Countries, Chapter V

* Attachment III-1, "Clinical Signs of Kwashiorkor and Nutritional Marasmus"

* Attachment I-9/3-A, "The Four Roles for a Structured Meeting"

Trainer Notes

Refer to the Health and Nutrition bibliography for additional resources on maternal and child health.

Materials: Newsprint and felt-tip pens, projector and screen (optional), relevant visual aids: photos, stories, music (See Trainer Notes, Steps 1 and 2)

Procedures:

Step 1. (20 minutes)
Introduce the session by setting a climate.

Trainer Notes

It is effective to use some innovative communication tools to introduce this session. Recorded songs by women or children at work or play, sketches, stories, personal accounts by women talking about life and well-being, a film such as is listed in the resources, all serve to offer glimpses into the realities faced by women and children. It is particularly effective if the film, song, story, etc. originate from the country in which the participants will be serving as Peace Corps Volunteers.

Step 2. (15 minutes)
Have the participants form small groups and distribute several photographs of malnourished children to each group. Encourage discussion within the groups.

Trainer Notes

Post the following questions on newsprint and explain that they are intended to help guide the group discussions:

* What does the picture show?
* What response does it evoke?
* Why is this condition present?
* What can be done about it?
* How can Volunteers assist?
* What information is needed to better understand the conditions we see?

Refer to Jelliffe, Morley, Cameron for photographs.

Step 3. (15 minutes)
Reconvene the groups and have them share their responses to the photographs.

Step 4. (15 minutes)
Present a brief talk on maternal and child health risks in the Third World and distribute and review Attachment III-1, "Clinical Signs of Kwashiorkor and Nutritional Marasmus."

Trainer Notes

In your brief talk, it is suggested that you cover the following points:

* High risk groups: pregnant women, lactating women, infants and young children to five years

* Degenerative and infectious disease patterns

* Definitions of states and signs of malnutrition: PCM, Marasmus, Kwashiorkor, deficiencies

* Birth to school-age health needs

A recommended resource for preparing the talk is Jelliffe, Child Nutrition in Developing Countries.

Step 5. (10 minutes)
Have participants brainstorm a list of ideas why women and children are considered "high risk." List the responses on newsprint.

Trainer Notes

Encourage a focus on issues, not specific diseases. Ideas may include:

* Need for or lack of nutrients in daily diet
* Changing patterns of eating
* Poverty
* No access to land
* Tradition

Step 6. (10 minutes)
Have the group list responses to the following question: What do you think are some specific diseases or conditions from which women and children suffer in developing countries?

Trainer Notes

Some examples might be: colds, respiratory ailments, pneumonia, starvation, blindness, pellagra, rickets, anemia, hemmorhage, infection, diarrhea, dehydration, measles, mumps, chicken pox, tooth decay, bewitchment, mental illness, poisoning from chemicals, etc.

Step 7. (15 minutes)
Have the participants compare and discuss the relationships between the risk factors listed in Step 5 and the specific diseases listed in Step 6.

Trainer Notes

Stimulate discussion by asking:

* Which diseases appear to be associated with a number of risk factors?
* Which risk factors seem to influence most directly health or illness?
* Can we make any generalizations?

Step 8. (5 minutes)
Have the participants form interest groups and develop presentations on potential volunteer strategies for responding to maternal and child health care issues and related illnesses.

Trainer Notes

Explain that each interest group should select one topic for investigation and research and be prepared to present their conclusions and recommendations in the next Health and Nutrition session.

As guidelines, mention that the presentations should:

* Use the "Four Roles for a Structured Meeting," from Attachment I-9/3-A

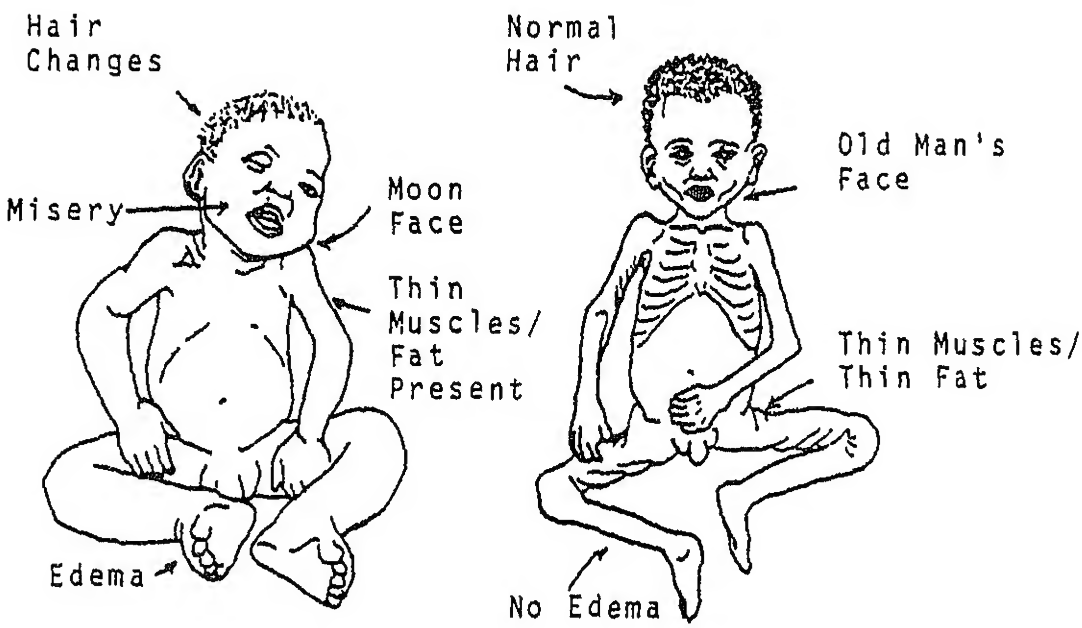
* Include economic, cultural, political, environmental and medical factors

Suggest topics for the interest groups (i.e., bottle baby syndrome, chemical dumping, female circumcision, taboos (sexual and dietary), labor, etc.

Present any available resources that would be helpful for the group's investigations.

Step 9. (5 minutes)
Briefly review the session objectives.

CLINICAL SIGNS OF KWASHIORKOR AND NUTRITIONAL MARASMUS



Underweight

KWASHIORKOR

Very Underweight

NUTRITIONAL MARASMUS

THE PATH OF THE SUN

Total time: 2 hours

Objectives:

* To determine the path of the sun during the day and its changes during the year
* To read a sun chart in order to find the azimuth and altitude of the sun to within 3^{o}

Resources:

* Bennett, Sun Angles for Design, pp. 27-53
* Mazria, Passive Solar Energy Book, pp. 5-13, 302-338
* U. S. D.O.D., Magnetic Variation Map of the World
* Attachment III-2-A, "Finding Azimuth"
* Attachment III-2-B, "Reading a Sun Chart"

Materials: Sun angle charts for the latitude of the training site and the latitude of each participant's country (See Trainer Notes, Step 6), sun angle calculator, heliodon, newsprint, felt-tip pens, tape, thumbtacks

Trainer Notes

The sun angle calculator can be purchased from Zomeworks Corporation, Box 712, Albuquerque, New Mexico 87103 ($60.00). The heliodon plans can be purchased from Farallones Institute Rural Center, 15290 Coleman Valley Road, Occidental, California 95465 ($3.00).

Procedures:

Step 1. (5 minutes)
Present the objectives and describe the session activities.

Step 2. (20 minutes)
Using the sun angle calculator and the heliodon, demonstrate how to determine the paths of the sun at the training site and distribute the sun angle charts for the latitude of the training site.

Trainer Notes

Once you have set the sun angle calculator to the latitude of the training site, have a participant describe the sun's daily path at several different times of the year.

Continued

Trainer Notes/Continued

Point out:

* The azimuth (compass reading) of sunrise
* The altitude (height above the horizon) at noon
* The azimuth of sunset for the time of year during training
* The equinoxes
* The solstices

Some sample questions for discussion include:

* What are the two days of the year when the sun rises due east and sets due west?
* Does this hold true for all latitudes?
* How can you calculate the altitude of the sun at noon during the equinoxes?
* What does "equinox" mean?
* What direction should a solar collector face at the training site?
* What would be the tilt of the collector optimal summertime collection, optimal wintertime collection and for year-around collection?

Step 3. (20 minutes)
Discuss the path of the sun at the equator.

Trainer Notes

Move the visor of the sun angle calculator to the vertical position (that of the equator) and ask:

* What can you say about the day-length on the equator?
* What direction would a solar collector face on the equator for optimal collection March through September? September through March? For year-around collection?

Step 4. (10 minutes)
Post the magnetic variation map of the world on the wall and have the participants find the latitude or range of latitudes for the country in which they will be serving.

:es)
;cuss the participant's host
charts and describe how a north
: can be converted to a south
:.

Trainer Notes

Prior to this session, you should determine the latitude or range of latitudes for each country and prepare one or two copies of the appropriate sun chart (Bennett, pp. 27-53) for each participant.

For example, if five participants are going to Zaire (which ranges from 0° to 4° north latitude) and you want each participant to have two copies of each latitude, make 10 copies of 0° and 10 copies of 4° sun charts.

* To change a northern latitude sun chart into a southern latitude sun chart, invert the sun paths shown on the chart (June 21 changes with December 21; July 23 and May 20 change with November 22 and January 21, etc.) and invert the horizontal axis, solar azimuth (degrees) so that the numbers read: 180, 160, 140, 120, 100, 80, 60, 40, 20, 0/360, 340, 320, etc.

* Sun charts for latitudes near the equator can be confusing because it looks as if the sun path goes off the chart to the left. You can clarify this by pointing out that the sun path continues by coming back onto the chart from the right.

* Explain that the sun charts are a two-dimensional representation of a hemisphere, so that when the sun path (which travels through the three-dimensional hemisphere) is transferred onto them, some liberties must be taken.

Step 6. (20 minutes)
Distribute and review Attachment III-2-A, "Finding Azimuth," and discuss the magnetic variation at the training site.

Trainer Notes

* This attachment is made for the San Francisco area of California, U. S. A. It is recommended that if this training is done elsewhere, a new Attachment III-2-A be made prior to this session using information found on the <u>Magnetic Variation Map of the World</u>. Attachment III-2-A can be used as a guide.

* Explain the reason for a magnetic variation and the difference between an eastern and western variation, using the attachment as a guide.

Step 7. (10 minutes)
Have a volunteer find the magnetic variation for the country in which he/she will be serving on the map of the world and indicate it to the group.

Step 8. (10 minutes)
Distribute Attachment III-2-B, "Reading a Sun Chart," and have the participants read the instructions and complete it.

Trainer Notes

Allow the participants to work in groups of two or three to complete this attachment. This helps people to learn, reduces competition and strengthens the cooperation of the group.

Step 9. (5 minutes)
Have the group discuss and explain their sun chart computations.

Trainer Notes

* Let the participants determine the answer. Then check to see if it's correct.

* Allow participants to make their own corrections.

* Explain that it is important to be able to read the sun chart in order to site a solar collector so that it is not shaded during critical hours.

* Remind the participants that shade mapping and solar siting will be done in Phase IV: Session 8 and that the sun charts will be needed at that time.

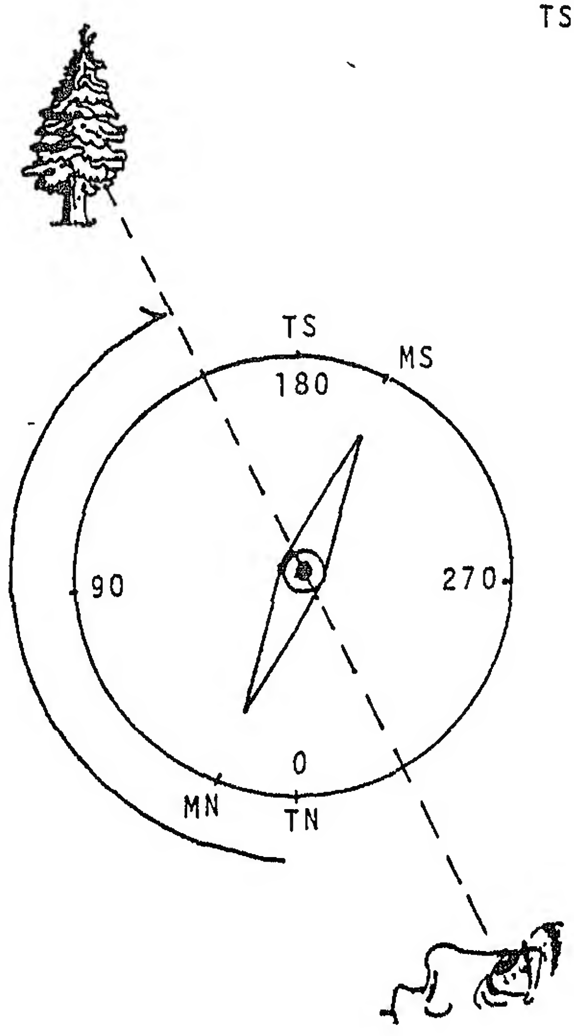
FINDING AZIMUTH

The magnetic variation of the training site is 17°E. This means that Magnetic North is 17° east of True North. It also means that True South is 17° east of Magnetic South (see illustration). The magnetic variation of your host country will be different. It can be found on the Magnetic Variation Map of the World.

The illustration shows the placement of a compass to show the corrected azimuths. By lining up the three points of your eye, the center of the compass and the potential shading obstacle, you can find the azimuth of that obstacle. The angle of the obstacle is found by reading from True North (160° in the illustration).

Key

MN = Magnetic North
MS = Magnetic South
TN = True North
TS = True South



READING A SUN CHART

Instructions:

Using a sun angle chart for the training site, find the compass direction (azimuth) and angle above the horizon (altitude) of the sun for the dates and times shown. Answers should be within 3^o of the group consensus answer to be correct, since the chart is small and some answers must be interpolated.

Given:

Date	12/21	3/20	4/10	7/24	6/17	9/30
Time	10 am	3 pm	11 am.	4 pm	8 am	noon

Find:

Azimuth					
Altitude					

INTRODUCTION TO PEDAL/TREADLE POWER

Total time: 2 hours

Objectives:

* To discuss and share past experiences with pedal/treadle power
* To discuss the history of technology and innovation and the history of the development of pedal/treadle devices as a renewable energy technology
* To identify and categorize pedal/treadle devices

Resources:

* Jequier, Appropriate Technology: Problems and Promises, pp. 13-17
* McCullough, Pedal Power, pp. 1-25
* Darrow, Keller & Pam, Appropriate Technology Sourcebook, Vol. I and II

Materials: Newsprint and felt-tip pens

Trainer Notes

To help illustrate your talk in Step 3 of this session with pictures of treadle and pedal devices, refer to the resources listed above and select several of the illustrations found in them. These pictures should be distributed to the participants.

Procedures:

Step 1. (25 minutes)
Ask the participants to form small groups. Have each group discuss and record their past experiences and/or knowledge of pedal/treadle power.

Trainer Notes

Explain that each group should list on newsprint what pedal/treadle devices they have seen and what devices they have read about.

Step 2. (30 minutes)
Reconvene the groups and have them discuss their experiences and knowledge of pedal/treadle power.

Trainer Notes

Be certain that each group posts their list of devices. Leave the lists posted. They will be referred to again in Step 4.

Step 3. (50 minutes)
Give a brief talk on the history of technology and innovation and the history of the development of pedal/treadle power as a renewable energy technology, mentioning some of its different applications along with some specific examples of successful devices.

Trainer Notes

Background material for this talk can be found on pp. 13-14 of Jequier and pp. 1-25 of McCullough. During the talk, distribute copies of the illustrations of pedal/treadle devices (found in the session resources) and briefly describe each one. At the end of the talk, encourage questions, comments or discussion.

Step 4. (15 minutes)
Have the participants categorize the devices listed by the groups in Step 1 and the devices introduced during the talk in Step 3.

Trainer Notes

The devices can be placed into the general categories:

* Agricultural tools
* Shop tools
* Home implements
* Transportation

Post these categories on newsprint and list the devices under them.

Step 5. (10 minutes)
Conclude the session by reviewing the objectives and mentioning that participants should consider the devices listed as possible construction projects during this phase.

DESIGN CONSIDERATIONS FOR PEDAL/TREADLE POWER

TOTAL TIME: 2 hours

Objectives:
* To list and discuss criteria for the selection of a technology
* To identify and discuss technical and cultural factors to be considered when designing an appropriate pedal/treadle device

Resources: Attachment II-5-B, "Criteria for the Selection of Technology"

Materials: Chalkboard or newsprint and felt-tip pens

Procedures: Step 1. (5 minutes)
Have the participants name two or three common manufactured items that they might choose for use in their everyday lives.

Trainer Notes

These items could be just about anything: an automobile, a pair of shoes, a tool, etc.

Step 2. (20 minutes)
Brainstorm a list of the technical and cultural criteria that one might use in choosing each item.

Trainer Notes

In the case of an automobile, for example, the criteria list might be:

Automobile

Technological Criteria	Cultural Criteria
Durability	Style
Ease of repair	Status
Etc.	Etc.

Step 3. (20 minutes)
Have participants examine the criteria lists and suggest any changes, additions or deletions which would be necessary when considering the design of pedal/treadle devices.

Trainer Notes

Explain that essentially the lists would remain the same.

Step 4. (60 minutes)
Distribute Attachment II-5-B and discuss the implications which arise when the issue of "appropriateness" is introduced as a selection criteria.

Trainer Notes

ourage the participants to compare and contrast the criteria ntified earlier in the session with the criteria outlined in attachment.

Step 5. (15 minutes)
Conclude and summarize the session by reviewing and discussing the objectives.

Trainer Notes

s a summary point, explain that along with the technical ppropriateness of a technology, various socio-cultural ssues play an essential role as selection and design onsiderations.

xplain that this basic point should provide the context or decisions made during the design and construction omponent of this phase.

he next session requires that three participants volunteer o do presentations of mechanical principles. Take time to elect these volunteers now. Explain to them the procedres for the next session (See Session 5 for details, proedures and attachments).

CLASSICAL MECHANICS: PRINCIPLES OF PEDAL/TREADLE POWER

Total time: 2 hours

Objectives:

* To demonstrate and discuss the mechanical principles of torque, momentum, inertia and sprocket ratios
* To discuss the application of these mechanical principles to pedal/treadle-powered devices
* To practice facilitation skills

Resources:

* Meriam, Mechanics
* Attachment III-5-A, "Demonstration of Torque"
* Attachment III-5-B, "Demonstration of Momentum and Inertia"
* Attachment III-5-C, "Demonstration of Sprocket Ratios"
* Attachment III-5-D, "Ratio Designs" Worksheets

Materials: Newsprint and felt-tip pens; materials listed in attachments.

Trainer Notes

This session will require advance preparation. Part of this preparation should have been made at the end of Session 4 with the selection of three participants to present the demonstrations in this session. Each of the three participants/facilitators should choose one of the three demonstrations and be provided with the corresponding attachment. (See Resources.)

Be certain to allow sufficient time before the session for the facilitators to prepare their demonstrations and provide them with the materials necessary. If the participant feels that he/she can present the principle in a more effective manner, encourage the development of that demonstration. Explain they they have 15 minutes to present the demonstration and 20 minutes for follow-up discussion.

Plan for time at the end of each of the three demonstrations for feedback on the facilitation skills of the individual giving the demonstration. You can encourage this feedback by asking the facilitator what he or she feels was best during the demonstration and where improvements could be made.

Step 1. (40 minutes)
Have the participant/facilitator demonstrate the concept of torque as outlined in Attachment III-5-A.

Trainer Notes

You should fill in any points missed or not covered to your satisfaction during all three of the demonstrations or discussions.

Step 2. (40 minutes)
Have the second participant/facilitator demonstrate the effects of momentum and inertia as outlined in Attachment III-5-B.

Step 3. (40 minutes)
Have the third participant/facilitator demonstrate the principles of sprocket ratios as outlined in Attachment III-5-C.

Trainer Notes

At the end of this session, distribute Attachment III-5-D, the "Ratio Designs" worksheets, explaining that the worksheets should be completed for the next day's session.

DEMONSTRATION OF TORQUE

Through this demonstration, the participants will gain practical understanding and experience with the effects of torque and its relationship to pedal/treadle power devices.

Total time: 40 minutes

Materials: 2 boards of equal length and nails

Procedures:

Step 1. (15 minutes/Steps 1-4)
Nail 2 boards together in a V-shape.

Step 2.
Have a participant grasp the two boards at the middle and attempt to pull them apart by opening the V. Point out the force required to move the boards.

Step 3.
Repeat the experiment by having another participant grasp the ends of the boards.

Step 4.
Compare the force required to move the boards when they are grasped at different distances from the juncture.

Note

The conclusion will be that it takes much less force to pull boards apart at the end mark, i.e., equal forces exert more effect on the juncture when they are at a greater distance from it.

Encourage the participants to express the relationship between applied force and the distance at which it is exerted, using the boards as an example. Such a relationship describes torque and may be expressed in the following formula:

torque = force applied x distance of applied force to the point of juncture

Step 5. (20 minutes)
Facilitate a discussion of the methods that might be used to minimize the effects of torque.

Step 6. (5 minutes)
Encourage feedback on your facilitation skills.

DEMONSTRATION OF MOMENTUM AND INERTIA

This demonstration will enable the participants to experience the effects, parameters and relationships of momentum and inertia to pedal/treadle power.

Total time: 40 minutes

Materials: Wheel or disk, axle, 4 weights (total weight approximately equals that of the wheel or disk)

Procedures: Step 1. (15 minutes/Steps 1-5)
Mount the wheel or disk on a shaft so that it can be easily rotated.

Step 2.
Have a participant rotate the wheel at an approximate set speed, taking note of the force required to start it rotating and the time it takes to coast to a stop after the force is withdrawn. Then, have a participant again rotate the wheel up to speed and then try to stop it quickly, noting the force required to stop the motion.

Step 3.
Distribute four weights equally around the outside of the wheel and repeat the procedure.

Step 4.
Ask the participant to note the effects of the added weights.

Note

The conclusion will be that it takes more effort to start the wheel rotating with the added weight but that the wheel rotates freely for a longer time.

Step 5.
Encourage a discussion of the relationships betwe parameters of momentum (which are the initial wei of the wheel and its added weights), the wheel's rotational velocity and its radius.

Step 6. (20 minutes)
Facilitate a discussion of the application of the principles of momentum and inertia to pedal/ treadle design.

Step 7. (5 minutes)
Encourage feedback on your facilitation skills.

DEMONSTRATION OF SPROCKET RATIOS

This demonstration allows the participants to experience the effects, parameters and relationship of sprocket ratio to pedal/treadle power.

Total time: 40 minutes

Materials: Multiple speed bicycle

Procedures: Step 1. (15 minutes/Steps 1-4)
Put the bicycle in low gear and lift the rear wheel off the ground. Ask the participants to observe how many times the rear wheel rotates for each revolution of the pedal crank.

Step 2.
Change the gear ratio to a higher gear and repeat Step 1.

Note

In the above two steps, ask the participants to observe the relative difference in force necessary to turn the pedal crank.

Step 3.
Have the participants develop the formula which defines the relationship between sprocket sizes and rotation speed.

Note

This relationship is defined as:

$$\frac{\text{size sprocket A}}{\text{size sprocket B}} = \frac{\text{velocity sprocket B}}{\text{velocity sprocket A}}$$

Step 4.
Facilitate a discussion of the potential mechanical advantage when sprockets are oriented in the proper fashion.

Note

The conclusion will be that transferring energy from a small to a large sprocket results in a velocity loss but in a mechanical advantage or gain.

Step 5. (20 minutes)
Facilitate a discussion of the application of the principles of sprocket ratios to pedal/treadle power.

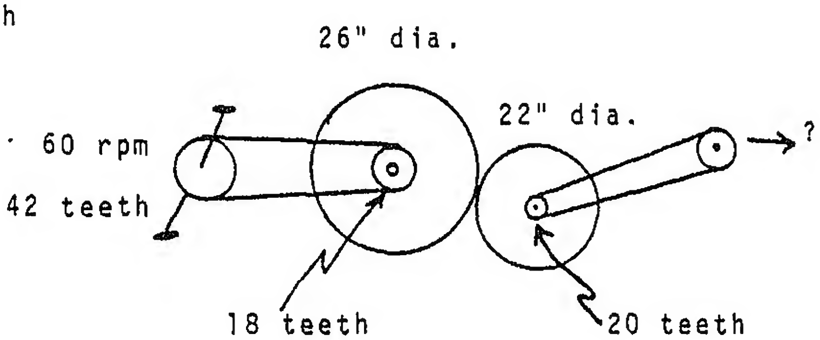
Step 6. (5 minutes)
Encourage feedback on your facilitation skills.

RATIO DESIGNS WORKSHEET

1. Given the mobile dynapod designed to power a food grinder that operates at 100 revolutions per minute, size the sprocket that will be connected to the grinder shaft:

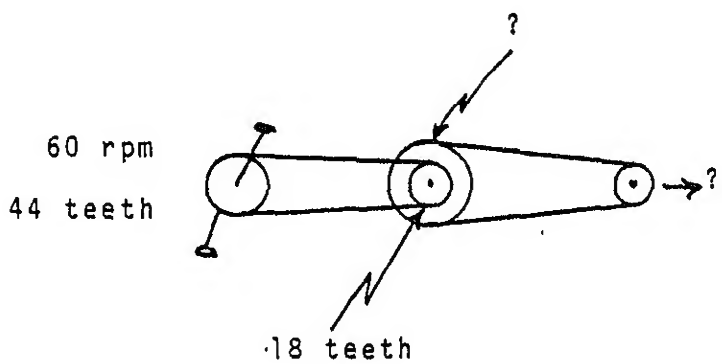
   Available sprockets:

   35 teeth
   42 teeth
   48 teeth
   18 teeth
   22 teeth
   30 teeth



2. Given the stationary dynapod, size the two sprockets in question to provide the required 400 revolutions per minute output in low gear on the bicycle.

   1st gear: 1.4/1
   2nd gear: 1/1
   3rd gear: 1/1.4

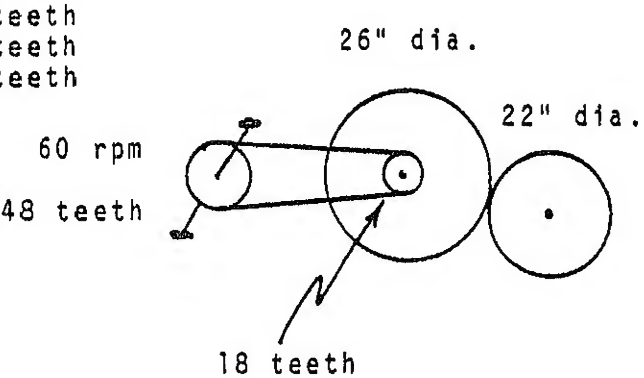


IGNS WORKSHEET/Continued

gn a mobile dynapod unit that will provide the driven
ut shaft speed of approximately 1,200 revolutions per
te necessary to power a bench grinder. The bicycle
will have a front sprocket of 48 teeth and a rear
sprocket of 18 teeth.

lable sprockets:

eeth
eeth
eeth
eeth
eeth
eeth



ign a system which will deliver power in a linear mode
a water pump designed to operate at 15 cycles per min-
. Pedaling speed of 60 revolutions per minute will be
d with a belt/pulley combination. The pump has a
ving rod throw of 8".

USE OF APPROPRIATE AIDS TO COMMUNICATION

Total time: 2 hours

Objectives:

* To discuss the need for creating relevant audio-visual aids for use in development work
* To identify and list various aids to communication which can be used in developing countries
* To make and use some appropriate aids to communication

Resources:

* Fuglesang, Applied Communication in Developing Countries
* Peace Corps, Visual Aids Number 2
* Pett, Audio-Visual Communication Handbook
* Bertrand, Communications Pretesting
* Attachment III-6-A, "Extension Skills"
* Attachment III-6-B, "Selecting Communication Tools"

Materials: Newsprint and felt-tip pens, a variety of examples of audio and visual aids, i.e. posters, flannel graphs, puppets, games, newsletters, papers, photo novels, comic strips, cassette tapes, slide/tapes, filmstrips, overhead transparencies, etc.

Trainer Notes

The examples listed above are particularly effective if they have been developed for use in a Third World setting and carry messages pertaining to development issues, i.e., health, nutrition, sanitation, literacy, family planning, agriculture, etc.

Procedures:

Step 1. (15 minutes)
Begin the session by reading the "Story of the Tsetse Fly" from Applied Communications in Developing Countries, page 13. Then present a short talk on the need for creating relevant audio-visual aids for use in development work.

Trainer Notes

A useful reference source is located on pp. 88-114, "Creating Visual Aids," in Applied Communications in Developing Countries.

Step 2. (10 minutes)
Have participants brainstorm a list of different communication aids that might be applied in development projects.

Step 3. (10 minutes)
Referring to the list, facilitate a discussion of the strengths and weaknesses of different communication aids for use in development work.

Step 4. (20 minutes)
Pass out the different examples of communication aids, briefly describing each one. Encourage any questions or discussion.

Trainer Notes

Also circulate copies of the resource materials for this session and discuss them with the group.

Step 5. (10 minutes)
Distribute Attachments III-6-A, "Extension Skills," and III-6-B, "Selecting Communication Tools," and review them with the group.

Step 6. (55 minutes)
Have participants form small groups and prepare appropriate audio-visual aids for use in the next session.

Trainer Notes

Phase III: Session 7 which follows, "Maternal and Child Health," includes group presentations on health topics.

Encourage the groups to apply what they have learned in this session to prepare for the presentations in the next session, i.e., incorporating a poster or other visual aid, a game, a skit, a song, a script for a radio broadcast, etc.

Also encourage the participants to apply this knowledge in their presentations at the end of technical phases and during the Energy Fair.

EXTENSION SKILLS: Important Points to be Considered for Successful Education and Communication

1. Be prepared. Know what you are doing, where you are going and what you want your audience to know when they leave. Don't prepare your talk an hour before you give it.

2. Always do a practice run of whatever it is you are demonstrating before you get up in front of the group to teach.

3. Start off with a very small chunk of information to be taught. For example, "How to Build a Stove" would be too broad a topic. Change it to "Building the Base."

4. People learn best by doing. The more concrete you can be, the better. For example, if you are doing a talk on how to make a particular type of soup, have everyone make it and taste the soup.

5. People remember main points better when presented with visual aids. Illustrate your main points and use the drawings during your talk. Also, people tend to understand complex or abstract concepts if they can visualize them. Also remember that points or concepts you find simple, others may find difficult. Be sensitive to your audience and explain points thoroughly.

6. Visual aids and/or graphs should be clear, depicting objects with which the people are familiar. Photographs or pictures cut from magazines are often more easily understood than hand-drawn pictures.

7. Changing color and lettering can draw more attention to the visual aids. However, visual aids may be distracting, confusing or misunderstood when they do not mirror people's reality.

8. A vocabulary list of important things, steps and materials in the demonstration can be useful to the demonstrator as well as to the audience.

9. The demonstration should never take place above the audience's line of vision.

10. People remember things that are unusual or make them laugh. But don't overdo it.

11. Physical conditions are important. The demonstration should take place in the lightest part of the room or area. Rooms should be freed of all other distractions. Effort should be made to make everybody physically comfortable, etc.

12. It's better to have an active audience than a passive one.

13. Don't read your material.

14. Keep eye contact with your audience. In this way, you will build a rapport with them. Also, they will feel like you are talking <u>to</u> them and not <u>at</u> them.

15. Respect the audience members who already know how to do the thing that you're demonstrating and get them involved in helping you with the presentation.

16. Repeat the main points. For example, state them at the beginning of your talk, in the middle and at the end. Again the next day, repeat the main points or elicit them from your group before you go into any new information. In other words, build on the previous information.

17. Reinforcement activities following a talk can facilitate learning.

18. Always minimize the cost of the thing being demonstrated, making sure that the people have the economic resources necessary to do it on their own. Try to utilize materials found in the immediate area.

19. When the demonstration involves making something, it is always a good idea to have a finished example to show to the audience.

20. Variety in presentation styles and environment are important.

21. Your talk should contain an introduction that gives a purpose for the information you are going to give. Set the stage for your talk.

22. Try not to use very technical words in the demonstration.

23. Organize your information. For example, time/order, cause/effect, etc.

24. Whenever possible, relate what you are demonstrating to the local customs.

25. Keep your demonstration short and limited to the time of day and amount of time that the people have free.

26. If the demonstration involves several steps, either write or draw them so the audience has something to follow as you go, but be sensitive to the fact that some people do not know how to read or follow diagrams.

27. Try and involve as many of the people's senses as possible: taste, smell, touch, sight, sound.

28. Your personality is important. Smile and be friendly.

29. Speak slowly and clearly. You're probably speaking slowly enough when you think you're going too slow.

30. Don't talk down to your audience. Show them the respect you want them to show you.

31. At the beginning of the demonstration, explain briefly what you are intending to do. At the end, summarize what it is that you have done.

32. Be sensitive to your audience. If they are getting restless, you may be going too fast, going on for too long or they may not be understanding you.

33. BE YOURSELF!

Taken from CHP, Guatemala, Peace Corps Training Facility

Visual Aid	General Description	Recommended Audience Size	Advantages	Disadvantages
Chalkboard	Rigid surface painted green or black on which one can write or draw with chalk.	10 to 30 people. If used with more, a large board is needed and careful audience placement is necessary.	Inexpensive. Can be homemade, easily maintained, minimum of preparation. Used day or night. Audience participation.	Transport can be difficult in remote areas. Limited to the user's artistic ability.
Flannel Board	A piece of flannel, flannelette, terry cloth or felt cloth attached to a rigid surface on which cut-out figures will adhere if backed with flannel or felt cloth, sand paper or glued sand.	15 to 20 people. Audience size depends on the size of the flannel board and the size of the figures that are being used.	Inexpensive. Easily made from local materials. Easily maintained and transported in remote areas. Figures can be used in different presentations. Ideal for showing "sequence of events" and reviewing lesson, as figures can be brought back on the board.	Requires considerable advance preparation. Difficult to use out of doors if there is any wind. Some artistic ability is required if making homemade figures.
Posters	A message on a large sheet of paper, and with an illustration and a simple written message.	No limit, because it is not necessary for everyone to look at a poster at the same time.	Inexpensive. Easy to make. Requires a minimum amount of time to prepare and use. Easy to transport.	Deteriorate rapidly. Can confuse audience with too much or too little information. Need some artistic ability if making own posters.
Flip Charts	Illustrations on paper or cloth, usually larger than 21 cm by 27 cm; bound together with rings or string. They flip over in presentation.	15 to 30 people. Audience size depends on the size of the flip chart illustration.	Inexpensive. Can be homemade and can be easily transported. Good way to give information in sequence; because they are bound, illustrations stay in sequence.	Deteriorate with constant use. Some artistic ability required if making homemade flip-charts.

Visual Aid	General Description	Recommended Audience Size	Advantages	Disadvantages
Flash Cards	Illustrations made on heavy paper that is usually smaller than 21cm by 27cm. The illustrations are not bound but are arranged in sequence.	5 to 15 people. Because the illustrations are small, no more than 15 people should be in the audience.	Inexpensive. Can be homemade. Very easy to transport. Good way to give information in sequence to small groups.	Deteriorate with constant use. Some artistic ability required if making homemade flashcards. Easy to get out of sequence. Limited to small groups.
Bulletin Boards	A surface, at least 3/4m by 1m, into which stick pins can be placed. Drawings, photos and lettering can be displayed on the board.	No limit, because it is not necessary for everyone to look at the bulletin board at the same time.	Inexpensive. Can be homemade from local materials. Good way to present a "changing" message in areas where people gather.	If out of doors, weather damage can occur. Constant supply of good educational material to put on the board is needed.
Demonstration	Using actual ingredients, tools or land, the educator shows how something is done. Either at that time, or soon afterward, each audience member displays an ability to do the new thing.	1 to 30 people. Because it is difficult for an educator to follow up on more than 30 persons, this is the recommended limit.	Excellent way to use actual materials in a real situation. Uses local materials. Easy to understand by people not used to looking at illustrations. Good way to get audience participation.	Takes a lot of planning and preparation.
Film	Color or black & White, 16mm or 8mm cinema film, with sound, projected on a screen or wall.	30 to 100 people. Groups can be larger -- but it is difficult to have any discussion with larger groups.	Dramatic and gets the audience's attention. Shows motion and therefore helps explain step-by-step and time sequence very well.	Very expensive; requires expensive equipment, electricity and dark projection area. Difficult to transport and operate.

Visual Aid	General Description	Recommended Audience Size	Advantages	Disadvantages
Slides	35mm film in plastic or cardboard mounts 5cm by 5cm. *In color or black & white*, they are projected on a screen or a wall.	About 30 *people. Though slides* can be used with more people, the educator can stimulate better discussion among a smaller group.	Dramatic, less expensive than cinema film, excellent way to bring distant things to audience and to show time sequence. *Battery-operated projectors* available. *Local photos easily* made.	Easy to damage, easy to get out of sequence and project upside *down* or sideways. Requires projection equipment, needs electricity or batteries and darkened projection area.
Filmstrips	Strip of 35mm film, color or black and white. *Photographs* in sequence. Filmstrip projected on screen or wall. Uses *projector* with filmstrip adapter. Film-strips horizontal or vertical format.	About 30 people. Though filmstrips can be used with more people, the *educator can* stimulate better discussion with a group of this size.	Dramatic, less expen-sive than *film and slides. Once inserted* correctly in projector, impossible to get out of sequence. Can show photos of the real *thing and shows* se-quence in *time*. Battery-operated pro-jectors available. Relatively easy to transport.	*Requires* projection equipment, can be dam-*aged, requires either* mains or battery-supplied electricity. (Sometimes batteries are expensive.) *Requires* darkened projection area. Limited appropriate filmstrips available.

Adopted from <u>WORLD NEIGHBORS IN ACTION</u> *newsletter*.

MATERNAL AND CHILD HEALTH: PART 2

Total time: 2 hours

Objectives:

* To prepare and give a presentation to the group concerning maternal and child health issues
* To discuss the role of the Volunteer in improving maternal and child health
* To use a structured meeting format

Resources: Refer to Phase III: Session 1, "Maternal and Child Health: Part 1"

Materials: Newsprint and felt-tip pens; presentation guidelines (Phase III: Session 1, Step 8)

Trainer Notes

In this session, groups formed in Phase III: Session 1 will present the results of their investigations into maternal and child health topics. The planning for this session was done in Part 1 (Phase III: Session 1). The groups are expected to use "The Four Roles for a Structured Meeting" as a format for their presentations.

Step 1. (5 minutes)
Briefly introduce the session objectives and outline the activities.

Step 2. (5 minutes)
List the order of the presentations on newsprint and post the presentation guidelines (See Phase III: Session 1, Step 8).

Step 3. (one hour, 30 minutes)
Have the groups give their presentations.

Step 4. (20 minutes)
Discuss the presentations and the success in meeting the session objectives.

Trainer Notes

Have the recorders present their notes from the presentation and ask each process observer to comment on the meeting.

Discuss the session by raising the following questions:

Continued

Trainer Notes/Continued

* Did speakers keep to the issues and follow presentation guidelines?

* How do you feel about your role as a Volunteer in relation to issues raised?

* To what degree can we generalize about each of these issues?

* Did you learn about issues (or parts thereof) previously unknown to you?

* What were effective ways people presented information?

PART ONE:
FAMILIARIZATION WITH MATERIALS AND TOOLS

Total time: 1 hour

Objectives:
* To identify and discuss the various tools and material resources available at the training site and/or in the local community
* To discuss the role of available materials in the design process

Materials: All local relevant resources: wood, metal, bearings, ropes, pulleys, pipe, bamboo, fastenings, etc. and the tools to work them

Procedures:

Step 1. (5 minutes)
Present the session objectives and review the activities.

Step 2. (10 minutes)
Facilitate a discussion of the importance of taking into account available resources in designing a pedal/treadle device.

Trainer Notes

* Explain that ideally the design of any pedal/treadle or other appropriate technology device should use materials that are available locally.
* Mention that before designing any device, it is important to thoroughly assess what resources will be available.

Step 3. (45 minutes)
Take the group on a tour of the training site and/or local community, explaining and/or demonstrating the uses, qualities and purposes of all available materials and tools.

Trainer Notes

* Encourage a great deal of q
that by the end of the tour
familiarized with all avail
* You should pay special atte
workshops, using this time
safety (including location
safety and proper use of t

PART TWO:
FAMILIARIZATION WITH THE BICYCLE

Total time: 1 hour

Objectives:
* To discuss the major issues regarding the promotion and use of bicycle-powered devices in the Third World
* To disassemble a bicycle and identify the parts

Materials: Newsprint, felt-tip pens, bicycles, wrenches, screwdrivers, hammers, etc.

Resources:
* McCullough, Pedal Power
* Cuthbertson, Anybody's Bike Book
* Attachment III-8/2-A, "Bicycle Diagram"

Trainer Notes

* This session is optional and should be used at your discretion, depending upon the extent to which you wish to focus on the use of bicycles during the pedal/treadle phase.

* You should, however, spend some time discussing the issues involved in the use of bicycles in developing countries (See Step 1). Decisions regarding the extent to which bicycles will be emphasized during the phase should depend upon points raised during this discussion.

Step 1. (15 minutes)
Present the session objectives, distribute Attachment III-8/2-A, "Bicycle Diagram," and facilitate a discussion of the major issues involved in the promotion and use of bicycle-powered devices in developing countries.

Trainer Notes

During the discussion you should stress the following points:

* In many developing countries, bicycles are scarce and their primary use is for transportation.
* Given their scarcity and expense, it is unlikely that people would be willing to disassemble their bicycles for use in pedal-powered devices.
* If bicycles are used for power generation, mobile dynapod designs are more suitable than fixed designs.

Keep this discussion as specific as possible to the countries in which the participants will be working.

Step 2. (15 minutes)
Have the participants form small groups. Provide each group with a bicycle and ask that they identify the parts of the bicycle and develop a procedure for disassembling it.

Trainer Notes

Explain that the group members should assist one another in identifying the bicycle parts. When the groups have developed their procedure for disassembly, have each group verify the procedure with you.

Step 3. (30 minutes)
Have the groups disassemble the bicycles.

Trainer Notes

As the groups are working, circulate among them, encouraging participants to help one another and to try working together as cooperatively as possible.

Step 4. (15 minutes)
Reconvene the groups and encourage a discussion of the disassembly activity.

Trainer Notes

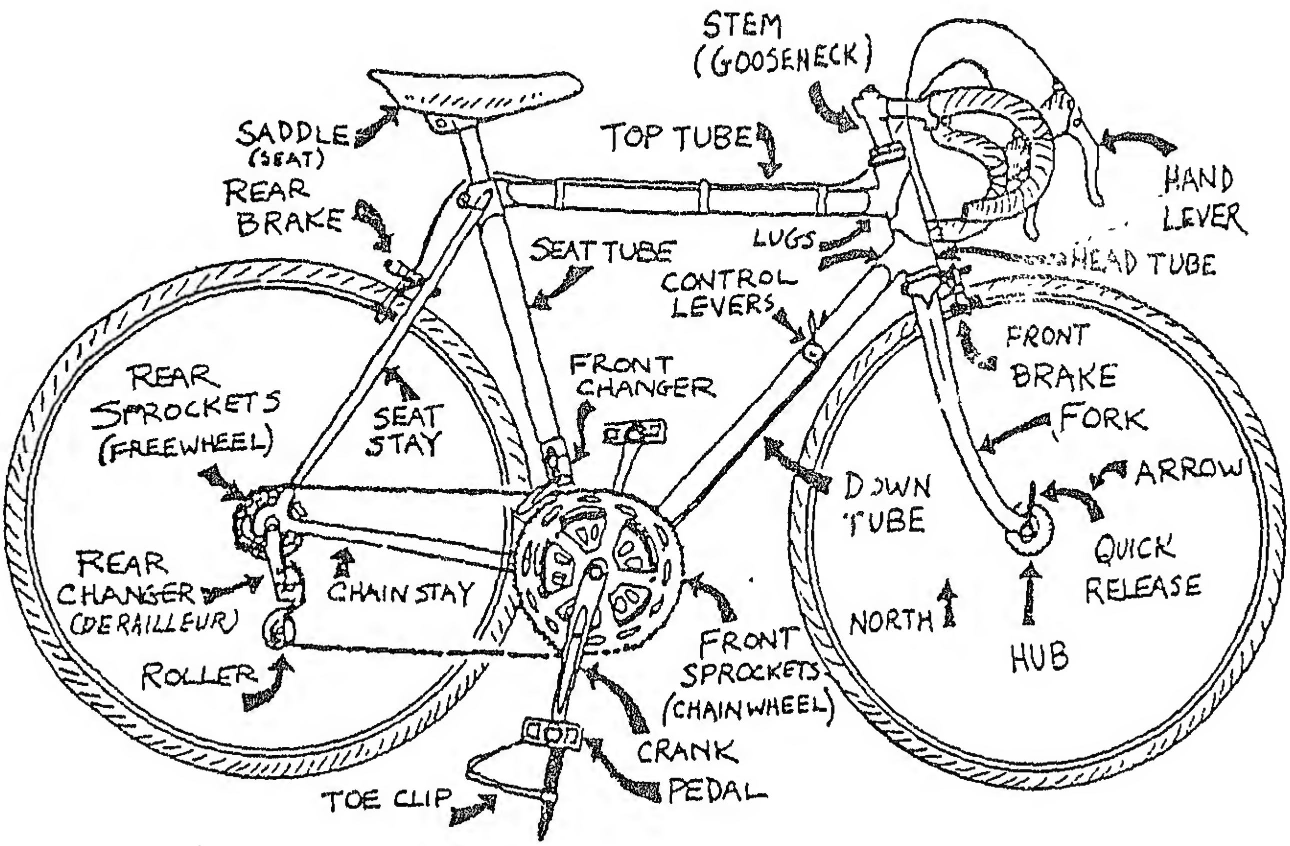
Stimulate this discussion by asking the following questions:

* Did you learn anything new about bicycles during this activity?

* Can you think of any ways in which bicycles might be used for generating power in your work as Peace Corps Volunteers?

* Was there anything which occurred during the activity that fostered the development of a sense of cooperation among your fellow group members?

BICYCLE DIAGRAM



The above illustration is that of a ten-speed bicycle, which is the most complex type.

Other types, such as single and three-speed, do not have multiple front sprockets and derailleur.

INTRODUCTION TO DESIGN CONSIDERATIONS

Total time: 4 hours

Objectives:

* To review and discuss the different qualities of foot-powered devices
* To review and discuss the basic concepts of the design and construction process
* To design a foot-powered device

Materials: Chalkboard, modeling materials (corks, pins, string, straws, glue, wire, toothpicks, rubber bands, tins, etc.

Resources:

* Attachment III-9-A, "List of Qualities of Foot-Powered Devices"
* Attachment III-9-B, "The Design Process"
* Hommel, China at Work

Trainer Notes

> This session should be scheduled at the end of the day so that the participants can continue their design project at home and have it ready for presentation the following day.

Procedures:

Step 1. (5 minutes)
Present the session objectives and activities.

Step 2. (30 minutes)
Distribute Attachment III-9-A, "List of Qualities of Foot-Powered Devices." Review the list, encouraging questions, comments and discussion.

Trainer Notes

> Explain that the better one can match the incoming energy source to the energy need, the simpler and more efficient the device can be. As an example, discuss the Chinese pedal-powered chain-and-washer pump, noting that the energy type and amount are so well matched to the energy needed that there is no requirement for a power system: it is direct-drive.
>
> While reviewing the list, ask the participants to define the terms "rotary" and "reciprocating." Discuss the possible applications of each drive system and their limitations.

Step 3. (1 hour)
Distribute Attachment III-9-B, "The Design Process," and review the process outlined. Encourage questions, comments and discussion.

Trainer Notes

* Draw Figure "A" from the attachment on the chalkboard. Review the diagram, emphasizing that no design is complete until it has been tested and retested and that every new design requires redesign and rebuilding. Ask the participants to give examples of design and redesign.

* Referring to the attachment (Part II), move the discussion on to the criteria for a design, emphasizing that specific criteria are more useful than general ones. Review the criteria found on the attachment.

* Draw Figure "B" on the chalkboard and explain that it is a more detailed look at the design process. Take the participants through the process, asking them for an example or offering an example. Ask at which point in the process one needs to consider the various qualities of foot-powered devices discussed earlier in the session.

* Conclude the discussion by explaining that they will be using this process in the design of their devices.

Step 4. (2 hours, 25 minutes)
Have the participants form small construction groups and explain that the remaining time should be used to prepare a design based on the criteria list for a foot-powered device that will be presented in the next day's session.

Trainer Notes

* Tell the participants that they will be working with their groups for the remainder of the phase. Explain that since they will be working together, they should be aware of and sensitive to group processes that are occurring. Suggest that they take time periodically to discuss ways in which the group could work together more effectively.

* Explain that each group should prepare a design for presentation during the next session, using models, posters, skits and/or other non-formal education techniques.

* Conclude by explaining that the group will eventually construct and evaluate their designs during this phase.

LIST OF QUALITIES OF FOOT-POWERED DEVICES

Type	Type of Motion	Speed	Power
Bicycle	Rotary	High	High
Treadle	Reciprocating	Medium	Medium
Kickwheel	Rotary	Low	Low
Chinese treadle	Rotary	Medium	Low
Weight shift	Reciprocating	Low	High
Treadmill	Rotary	Medium	Medium
Chinese pedal	Rotary	Low	High
Double treadle	Reciprocating	Medium	High

THE DESIGN PROCESS

I. Overview of the Whole Design Process

Design it

Build it

Test it

Redesign it

Figure A

II. A Closer Look at the Design Part

Establish criteria. Be specific, for example:
It must be buildable in 20 hours.
It must weigh less than 25 pounds.
It must use only wood.
It must be built only with hand tools.
It must be usable by both sexes, etc.

Establish priorities of criteria.

Create three proposed designs.

Select the best design.

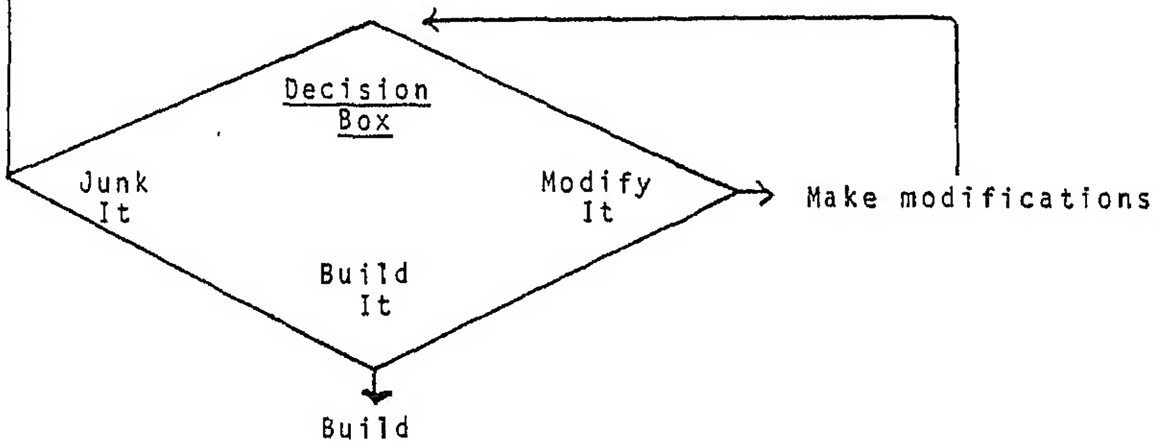


Figure B

PRESENTATION OF DESIGNS

Total time: 1 hour

Objective: To present and discuss the designs of pedal/treadle devices

Trainer Notes

Guidelines and preparations for the presentations to be done during this session are explained in Phase III: Session 9.

Resources: Phase Schedule written on newsprint

Trainer Notes

Before proceeding with this session, the Phase Schedule should be written on newsprint for use in Step 3.

Materials: Newsprint and felt-tip pens

Procedures: Step 1. (5 minutes)
Present the objectives and outline the session activities.

Step 2. (40 minutes)
Have each group present their designs.

Trainer Notes

Allow time after each presentation to give each group feedback on the presentation and design. Ask people what they liked best about the presentation and the design and what suggestions they might have for improvement.

Step 3. (15 minutes)
Post the Phase Schedule and discuss it.

Trainer Notes

Point out the remaining pedal/treadle sessions in the phase. Explain that in the next session, they will begin the construction of their devices. Emphasize the importance of careful planning to ensure sufficient time to complete the devices.

CONSTRUCTION OF PEDAL/TREADLE-POWERED DEVICES

Total time: 22 hours

Objectives:

* To use various tools in the construction of pedal/treadle-powered devices
* To build and test a pedal/treadle-powered device
* To recognize and solve problems, both with the construction of the pedal/treadle device and within the group

Resources:

* Darrow and Pam, Appropriate Technology Source Book, Volumes I and II
* McCullough, Pedal Power

Materials: An assorted quantity, quality and variety of: wood, wire, pipe, sheetmetal, bamboo, string, rope, old fanbelts and belt material, gears, bicycle chains, sprockets, bicycles and bicycle parts, nails, screws, nuts, bolts, bearings, leather, PVC pipe, grease, oil, wood and metal-working tools. Newsprint and felt-tip pens.

Trainer Notes

This session requires substantial preparation time for gathering the materials listed.

This 22-hour session allows much latitude for individual trainer styles.

It is not intended that this session should occur over 22 continuous hours. It should be complemented with other sessions such as Health & Nutrition, The Role of the Volunteer in Development and Core Technology sessions (see the Phase III calendar at the beginning of this phase). It is helpful, in fact, to spread the construction time over as many days as possible. This will allow the participants more spare time to discuss the projects outside of session time. However, a four-hour work period should be considered minimum, since tools and materials have to be set up and cleaned later. Six-or eight-hour construction periods are ideal.

Construction naturally follows design. Those groups with complete plans for their device should proceed with construction without waiting for the other groups to finish.

Step 1. (22 hours)
Have the participants form their construction groups and build their pedal/treadle-powered devices.

Trainer Notes

At the beginning of each day of construction, have the participants discuss the events of the preceding day. Focus the discussion on the group dynamics and problem solving methods being used in each group. Allow between 15 and 25 minutes for this activity, depending on the group needs.

It is also helpful to use this time to review the time remaining in the construction session and remind the participants that one hour near the end of the phase will be spent on the development of a presentation for their device (See Phase III: Session 15).

When time begins to get short, encourage the participants to focus on essential tasks only and to divide them among the group members to help speed up the process.

Be certain to keep in touch with how the groups are proceeding during the construction period, taking time when necessary to show people how to properly use and care for tools. Don't intervene every time a group or an individual makes a mistake since mistakes are an important part of the learning process.

Explain that any group finishing one project can (time permitting) go on with another small project or begin preparations for the presentation of their device.

Set aside 10 to 20 minutes at the end of each day's construction period for cleaning the work site and shop area.

At the end of the final construction session, set aside about half an hour for a thorough cleaning of the work site and the shop area.

BLACKSMITHING AND METALWORK

Total time: 2 hours

Objectives:
* To discuss and experiment with blacksmithing and metalwork techniques
* To discuss ways of effectively communicating with a skilled artisan

Materials: As needed by the blacksmith

Trainer Notes

It is important that the participants have a general knowledge of the capabilities and limitations of a blacksmith or metal-worker. In-country, a Peace Corps Volunteer may, on occasion, need assistance in the construction of a particular device. Therefore, it is important to adequately understand the fundamentals of blacksmithing in order to properly explain the work needed.

This session will require preparation. You will need to arrange for the participants to visit a blacksmith's shop in order to observe the blacksmith at work and learn some of the fundamentals of working metal: how to heat, work and temper in steel, how the forge works, what tools are needed, etc. The participants should be able to question the blacksmith and ideally have an opportunity to experiment with heating and working metal.

The smaller the group visiting the blacksmith, the better, as it will allow more one-on-one contact between the blacksmith and the participants and greater opportunity for hands-on practice. If the construction group is large, one option is to have the small construction groups stagger their visits to the blacksmith during the construction period. Much of this will depend upon the needs of the blacksmith and the amount of time he/she is willing to spend with the participants.

Resources and materials will be specified by the blacksmith.

Procedures: Step 1. (15 minutes)
Have the participants form their construction groups and develop a list of questions about the blacksmithing trade that have bearing on the construction of their pedal/treadle-powered devices.

Trainer Notes

Try to limit the list of questions to two or three per group to avoid overwhelming the blacksmith with too many questions.

Step 2. (1 hour, 30 minutes)
Reconvene the groups and have the participants visit the blacksmith shop.

Trainer Notes

Explain that during their visit, the participants should learn:

* The different types and qualities of metals, their advantages and disadvantages

* The availability and cost of metal types

* The availability of recycled materials

Also, explain that they should note any key points that they feel should be remembered when communicating with an artisan. Add that they will be discussing these points after their visit. (Also add that this discussion will take place at an appropriate location away from the blacksmith shop.)

Step 3. (15 minutes)
After the visit, have the participants summarize what they have learned about blacksmithing and communicating with a blacksmith. Encourage discussion, comments and questions.

APPROPRIATE TECHNOLOGIES FOR HEALTH

Total time: 2 hours

Objectives:

* To identify and discuss appropriate technologies for infant and child nutrition
* To practice making rehydration formulas and weaning foods
* To develop communication aids designed to promote weaning foods in developing countries

Resources:

* Werner, Where There Is No Doctor, pp. 107-124, 151-161
* Jelliffe, Child Nutrition in Developing Countries, Chapters 6 & 7
* Raphael, "Cultural Factors are Part of the Appropriate Technology for Weaning Foods," in APPROTECH, pp. 9-10
* Attachment III-13-A, "Guidelines for Feeding"
* Attachment III-13-B, "Weaning Foods"
* Attachment III-13-C, "A Measure for the Rehydration Formula"

Trainer Notes

We suggest that you copy some of the weaning food recipes for specific countries to which volunteers are assigned (see Step 2). Refer to Jelliffe for recipes.

Materials: Newsprint and felt-tip pens; several critical photographs (see Trainer Notes under Step 1); cookstoves and food grinders; cooking utensils, pots and pans; water, sugar, salt, grains, legumes, dark green and yellow vegetables, oil

Procedures: Step 1. (5 minutes)
Introduce the session by distributing and discussing selected critical photographs.

Trainer Notes

Effective photographs to focus the discussion have been: a mother force-feeding her infant, or an emaciated infant with a baby bottle.

Continued

Trainer Notes/Continued

Encourage discussion by asking the following questions:

* What is happening in these photographs?
* What appropriate technologies for health could be applied in these situations?

Step 2. (10 minutes)
Distribute and review Attachment III-13-A, "Guidelines for Feeding," and Attachment III-13-B, "Weaning Foods."

Trainer Notes

At this point, you should also distribute and explain copies of weaning food recipes that are specific to the countries in which the participants will be serving. (See Trainer Notes under Resources.)

Step 3. (10 minutes)
Review the rehydration formula and distribute and review Attachment III-13-C, "A Measure for the Rehydration Formula."

Trainer Notes

Refer participants to Werner, pages 107-124 and 151-161.

Step 4. (30 minutes)
Have participants form small groups and practice making rehydration drinks and weaning foods.

Trainer Notes

* Post a general recipe for mixing and cooking a weaning food on newsprint for all to see.

* Have all foods and implements ready for use.

* Encourage participants to try varying recipes.

* Offer help whenever necessary.

Step 5. (40 minutes)
Briefly reconvene the group and explain that they should continue working in their small groups to develop communication aids designed to promote the use of weaning foods in developing countries.

Trainer Notes

* Have materials available: newsprint, cardboard, pens, etc.

* Stimulate ideas by suggesting: gourd babies to demonstrate dehydration, role-plays, children's stories, cartoon strips, radio or press releases, songs, dances, games, etc.

Step 6. (15 minutes)
Reconvene the groups and have them present and explain their communication aids.

Trainer Notes

* Have the groups discuss ways to use their communication aids.

* Encourage the groups to give constructive feedback and suggestions for improvement of each aid.

Step 7. (5 minutes)
Review the session objectives and summarize the activities.

GUIDELINES FOR FEEDING

1. Breast milk is best:

2. Put a new-born baby to breast as soon as possible.

3. Start feeding thin porridge at four months.

4. At six months, feed plenty of porridge with added protein three times a day.

5. Start the baby on new foods before he has the breast milk. Once he likes it, give it to him after his breast milk.

6. Breast feed a child as long as possible (18 months to two years of age).

7. Stop breast feeding slowly.

* * *

Remember, a young child:

* Needs feeding often
* Needs a special plate
* Needs food to be well mixed
* Needs to be fed with a spoon

WEANING FOODS *

"It is no exaggeration to say that the most important global target for nutrition education is to persuade tropical parents to feed their children in the early years of life as well as possible with local foods produced in greater quantities in the village."

-D. B. Jelliffe-

Multimixes (4:1 ratios)

Double Mix	Staple + legume or animal protein or dark leafy green vegetable (DLGV)
Triple Mix	Staple + legume and animal protein or DLGV
Quadri Mix	Staple + legume and animal protein and DLGV

* * *

Weaning foods should be:

* Well cooked
* Soft and mashed
* Offer compact calories and protein

* Weaning = to accustom

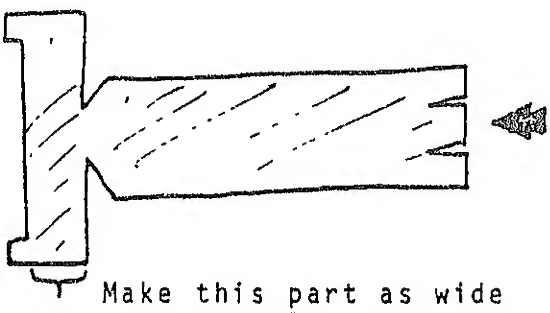
A MEASURE FOR THE REHYDRATION FORMULA

How children can make measuring spoons for preparing a SPECIAL DRINK to protect a child with diarrhea.

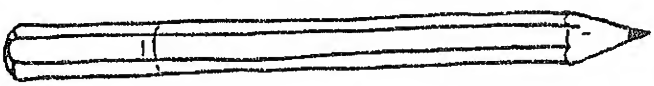
Children can make measuring spoons from many things, but it is important that they measure more or less the right amount of sugar and salt.

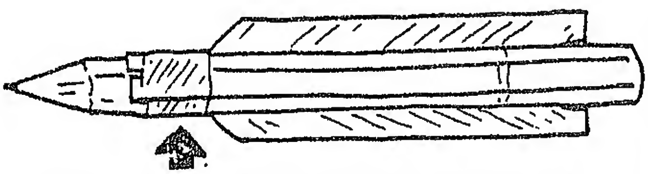
Here is one way to make spoons using things that have been thrown away.

1. Cut a juice or beer can to this shape. (It's easy with scissors.)

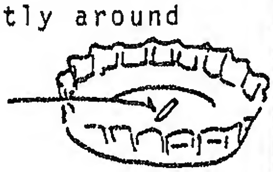


Make this part as wide as a pencil is thick.

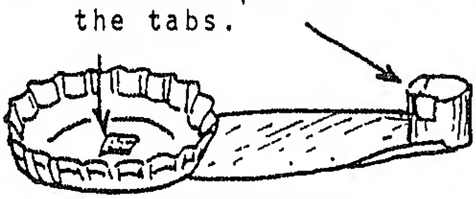




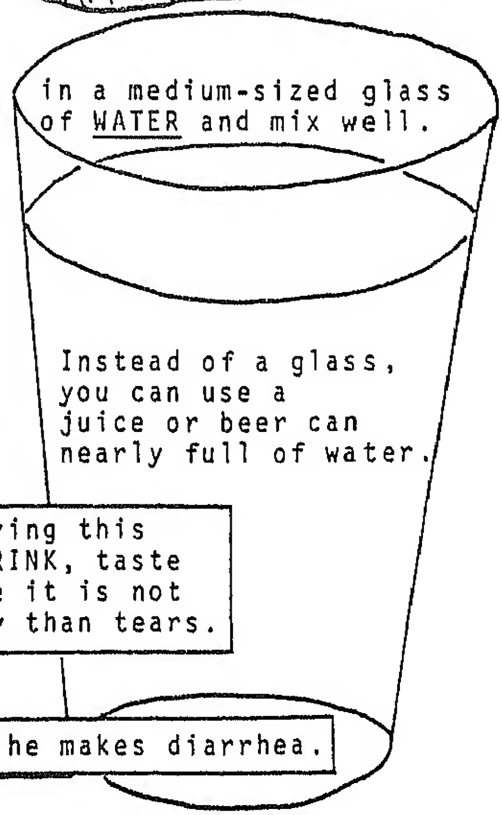
2. Wrap this part tightly around a pencil.



3. In the middle of a bottle cap, make a small cut.
4. Join the pieces and bend over the tabs.



Put 1 heaping bottle cap of SUGAR, and 1 little spoon of SALT



in a medium-sized glass of WATER and mix well.

Instead of a glass, you can use a juice or beer can nearly full of water.

Before giving this SPECIAL DRINK, taste to be sure it is not more salty than tears.

Give the child one glass of SPECIAL DRINK for each time he makes diarrhea.

From Hesperian Foundation.

CASE STUDIES IN COMMUNITY HEALTH

Total time: 2 hours

Objectives:

* To examine several case studies/films that describe various community health strategies
* To discuss some characteristics of community health strategies
* To select topics for presentations during the next health session

Resources:

* Werner, Where There Is No Doctor, pp. W1-W29
* Brownlee, Community, Culture and Care, pp. 136-154 and 214-262
* The Hesperian Foundation, "Health Care by the People, " a film
* World Health Organization, Film #13,"Health for All - Sankofa Tradition and Development"
* Werner, The Village Health Worker - Lackey or Liberator?
* World Health Organization, "World Health - Traditional Medicine"
* World Health Organization, "Appropriate Technologies for Health," newsletters.

Trainer Notes

It is useful, where possible, to locate some case studies for participants to review as additional reading. There are a number of good publications, such as "World Education Reports" and "Pan American Health," that are widely available and offer short articles on community health projects and systems in the developing world.

Before presenting this session, you will need to order the two films listed in the resources (see Steps 2 and 4).

Materials: Film projector and screen, newsprint and felt-tip pens

Procedures: Step 1. (5 minutes)
Review the session objectives and outline the activities.

Step 2. (35 minutes)
Show a film which illustrates a successful community health strategy.

Trainer Notes

* Refer to the resources for two films that have been very effective or substitute other films as desired.

* If the films are not available, an option is to locate written examples of case studies and have the participants review them.

Step 3. (15 minutes)
Have participants discuss their impressions of the film and identify some of the characteristics of community health strategies illustrated in the film.

Trainer Notes

The following questions can focus the discussion:

* Can you determine the philosophy of health?
* Is the health approach preventative, curative or both?
* Are health workers indigenous or foreign?
* What is the role of the traditional practitioner?
* Are traditional and modern health approaches integrated?
* Are appropriate technologies for health a part of the health system?

Step 4. (40 minutes)
Show a second film (or discuss another written case study).

Trainer Notes

For contrast, it is effective to show a second film (or read a second case study) which illustrates an unsuccessful health strategy.

Step 5. (15 minutes)
Invite comments about the film and have the participants identify characteristics of the community health strategy illustrated.

Step 6. (10 minutes)
Describe the plan for the next session and have participants form small interest groups to select topics for presentation.

Trainer Notes

Explain that their topics should be researched and that ten-minute presentations should be prepared for Phase V: Session 13.

Encourage participants to use appropriate communication aids in their presentations (i.e., role plays, visual aids, etc.).

Participants should first review Werner, pages W1-W29, and Brownlee, pages 136-154 and 214-262 for background information.

Effective topics that have emerged from past film discussions include:

* Village-based health workers or imported health teams
* Preventative vs. curative approaches to health
* Role of traditonal practitioners
* Philosophy of self-help health
* Integration of traditional and modern health systems
* Appropriate technologies for health
* Role of Volunteer in community health systems

PREPARATION FOR PEDAL/TREADLE PRESENTATIONS **

Total time: 1 hour

** This session should be scheduled at the end of the day so that the participants are able to finish the work during the evening hours.

Objectives:

* To plan and design a presentation of a pedal-powered device

* To identify and use techniques for communicating complex technical concepts to informally educated people

Resources: Fuglesang, Applied Communication in Developing Countries, pp. 43-52

Materials: Newsprint and felt-tip pens

Trainer Notes

Copies of the resource material should be prepared for distribution during the session.

Remember to schedule this session at the end of the day so that participants are able to finish the work during the evening.

Procedures:

Step 1. (5 minutes)
Present the session objectives and outline the activities.

Step 2. (10 minutes)
Distribute a copy of Fuglesand to each participant and have them read it.

Step 3. (15 minutes)
Have the participants brainstorm and discuss a list of ways to present their devices to informally educated people.

Trainer Notes

Write the list on newsprint. It should include some of the following nonformal education techniques: skits, puppets, songs, pictures, games, diagrams, slide shows, models, etc.

Encourage the participants to describe how these techniques could be used to explain a complex technical concept.

Step 4. (10 minutes)
Have the participants identify which techniques would be most appropriate for their presentations.

Step 5. (20 minutes)
Have the participants form their construction groups and develop a presentation of their pedal/treadle devices.

Trainer Notes

* Explain that each group should develop a twenty-minute presentation and that it should be designed to be understood by people with little or no formal education.

* Point out that informally-educated people may have difficulty understanding the mathematics of pedal/treadle concepts but if they are familiar with bicycles, they will probably understand the principles of leverage, wheels, fly wheels, momentum, inertia, rhythm, etc.

* Explain that they should continue to plan and practice their presentations tonight and that they should be prepared to give them tomorrow.

HEAT TRANSFER

Total time: 2 hours

Objectives:

* To define and discuss the different types of heat transfer
* To demonstrate types of heat transfer using non-technical language

Resources:

* Anderson, The Solar Home Book, pp. 62-74
* Mazria, Passive Solar Energy Book, pp. 5-20, 28-43

Materials:

* Heat source (sun, infrared lamp, burner at low heat, etc.)
* Various metals (iron, steel, lead, copper, aluminum, etc.)
* Glazing materials (glass, vinyl, polyethylene, etc.)
* Insulation materials (newspaper, cardboard, straw, etc.)
* Building materials (stone, brick, adobe, etc.)
* Thermometers, newsprint, felt-tip pens
* Model solar water heater and food dryer

Trainer Notes

This session requires substantial preparation to gather all of the materials listed above.

Procedures:

Step 1. (5 minutes)
State the objectives and outline the session activities.

Step 2. (15 minutes)
Define and discuss the three types of heat transfer: radiation, conduction and convection.

Trainer Notes

Encourage the participants to come up with their own definitions of the three types of heat transfer. (Since they have defined them in Phase III: Session 7,"Earthen Stoves," they should have little difficulty in forming a definition.)

Continued

Trainer Notes/Continued

Post the definitions on newsprint as they are formulated.

Ask for the differences in heat transfer between cookstoves and solar devices, such as water heaters and food dryers.

Step 3. (40 minutes)
Have the participants form small groups and develop demonstrations to describe one or two types of heat transfer.

Trainer Notes

* Mention that the demonstration should use simple, non-technical language.

* Tell them to assume the presentation will be given to people with little or no formal schooling.

* Explain that the materials which have been gathered are all available for use in the presentations or they can find and use other materials.

* Encourage the groups to use non-formal education techniques such as skits, visual aids, songs, dances, etc.

* Circulate among the groups and offer assistance where necessary.

Step 4. (45 minutes)
Have the groups give their demonstrations.

Trainer Notes

Discuss each demonstration after it is given. These questions will help to focus the discussion:

* What worked well during the demonstration?

* What didn't work well?

* Would the demonstration be understandable by people with little or no formal schooling?

* What could have been done differently to improve the demonstration?

Step 5. (15 minutes)
Discuss how types of heat transfer are applied to solar devices.

Trainer Notes

To stimulate the discussion, ask the following question:

How will these three types of heat transfer work for and against you in your solar devices?

Step 8. (5 minutes)
Have the participants clean up the area.

THE ROLE OF THE VOLUNTEER IN DEVELOPMENT: INTERNATIONAL DEVELOPMENT
PART 1: THE GREEN REVOLUTION: SUCCESSES AND FAILURES

Total time: 2 hours

Trainer Notes

"The Green Revolution: Successes and Failures" is a two-part activity. (Part 1 is Phase III: Session 17 and Part 2 is Phase IV: Session 1.) Part 1 introduces participants to issues and resource materials related to the transfer of technology in developing countries. In Part 2, participants debate the effectiveness of various methods of technology transfer.

The two sessions should be held on two successive days to allow sufficient time for preparation.

Objective: To identify and discuss issues involved in the transfer and development of technology

Resources:

* Lappé and Collins, Food First, pp. 121-177
* Rodale, Organic Gardening and Farming, "The Greening of the Green Revolution," pp. 23(7): 34-40
* Int. Institute of Tropical Agriculture, "Sowing the Green Revolution"
* Brush, Natural History, "Farming the Edge of the Andes," pp. 86(5) 32+
* Franke, Natural History, "Miracle Seeds and Shattered Dreams in Java," pp. 83(4) 10-12
* Gussow, The Feeding Web, pp. 395 - 399

Trainer Notes

* The resources cited above provide contrasting perspectives on issues relating to technology transfer.
* Other, more current, or area-specific resources can be used. If you decide to use other resources, it is important that they provide participants with contrasting or contrary views regarding the effectiveness of the Green Revolution as a development strategy.
* Before the session, make enough copies of the resources for all of the participants.

Step 1. (10 minutes)
Explain the objectives of the session by giving a short talk on past and present patterns of technology transfer and development in international development.

Trainer Notes

A suggested resource for developing this orientation is:

Warpeha, Paul, Perceptions of Technology: A Study of the Iluman Project, NTIS, Washington, D.C., 1979, Introduction.

Step 2. (10 minutes)
Review and explain the session procedures.

Step 3. (30 minutes)
Distribute the reading materials and allow the participants time to review them.

Step 4. (20 minutes)
Have the participants join one of three groups, explaining that in the up-coming debate:
Group #1 will take a position supporting the Green Revolution.
Group #2 will oppose the Green Revolution.
Group #3 will present possible alternative strategies for agricultural development programs.

Trainer Notes

As the participants select their groups, list their names on posted newsprint.

Step 5. (20 minutes)
Explain the debate procedures as outlined in Phase IV: Session I.

Trainer Notes

In order to follow debate procedure, it will be necessary for someone to serve as moderator with the responsibility of keeping time and maintaining the flow. If one of the participants has had debate experience, he/she should be asked to serve as moderator.

Brief the moderator thoroughly regarding the importance of following the debate procedures. Ask him/her to explain the basic groundrules for debate to the other participants.

Step 6. (30 minutes)
Explain that the groups should use this time to develop their debate strategies.

SENTATION OF PEDAL/TREADLE-POWERED DEVICES

al time: 4 hours

ectives:

* To present the pedal/treadle-powered devices using non-formal education techniques
* To discuss and evaluate the devices constructed during the phase
* To evaluate how the training went during the phase

erials: Completed pedal/treadle-powered devices; other materials as determined by the participants

cedures: Step 1. (5 minutes)
Present the session objectives and activities.

Step 2. (1 hour, 30 minutes)
Have the construction groups give their presentations.

Trainer Notes

At the end of each presentation, have the participants discuss what they felt was clear about the presentation, what wasn't clear and give any suggestions they might have for improving the presentation.

Step 3. (1 hour)
Have the participants discuss and evaluate each of the groups.

Trainer Notes

Guide the discussions to cover the following questions:

* What works best about the device?
* What is the weakest part of the device?
* Is it easy to use? Who can use it? Who cannot?
* Is it easy to maintain and repair?
* Did the design change during construction?

Step 4. (30 minutes).
Have the participants discuss and evaluate the pedal/treadle portion of Phase III.

Trainer Notes

Use the following questions as guidelines for the discussion:

* What was learned?
* Were expectations met?
* How could the phase be improved?
* How could the trainer have been more effective?

Step 5. (55 minutes)
Have the participants remove the devices and clean up the work area.

VOLUNTEERS IN DEVELOPMENT
PART ONE: WOMEN IN DEVELOPMENT

Total time: 2 hours

Objectives:
* To identify and discuss some of the issues of women in development (WID)
* To begin to clarify views, expectations and assumptions about women in developing countries

Resource: Tinker, "The Adverse Impact of Development on Women," in Women and World Development, pp. 1-9

Materials: Newsprint and felt-tip pens, props for the skits, i.e., cloth for clothing, hats, baskets, bowls.

Trainer Notes

This session will require some preparation. You will need copies of the Tinker article. It should be distributed ahead of time to allow participants an opportunity to read it before the session. Also, gather a selection of items that can be used as props for the skits (see Materials).

Procedures:

Step 1. (5 minutes)
Post the objectives and outline the session activities.

Step 2. (10 minutes)
Refer to the Tinker article and have the participants identify some of the major topics concerning women in development. Facilitate questions and comments about the issues involved in each topic.

Trainer Notes

* Mention the following women in development topics: urbanization, the introduction of new technology, education, the change in women's roles, and the growth of a cash economy.
* Record the topics on newsprint for use in the next WID session (Phase IV: Session 12).

Step 3. (30 minutes)
Have the participants form small groups and develop a 10-minute skit using one of the topics from the list as a theme.

Trainer Notes

Call their attention to the props and mention that they can use them in the skits.

Step 4. (60 minutes)
Have the group reconvene and present the skits.

Trainer Notes

This session was originally planned for six groups. If there are too few participants to form six groups, you may wish to extend the length of preparation time (Step 4) for each of the groups, or allow for a longer discussion (Step 5) or both.

Step 5. (20 minutes)
Discuss any general impressions created by the skits.

Trainer Notes

* During the discussion, have the participants identify issues that were brought out in the skits. Ask them how they might try to deal with these issues during their Peace Corps service.

* Conclude by briefly mentioning Part Two of Women in Development (Phase IV: Session 12).

MID-PROGRAM EVALUATION
PART ONE: PROGRAM EVALUATION

Total time: Approximately 4 hours
The total time may vary according to the number of participants and options exercised.

Objective: To evaluate the effectiveness of the program to date in meeting goals and expectations.

Resources:
* Attachment III-20/1-A, "Mid-Cycle and Final Evaluation of Training Goals"
* Attachment III-20/1-B, "Discussion Questions"
* "Expectation Lists," prepared in Phase I: Session 2

Materials: Newsprint and felt-tip pens

Procedures:

Step 1. (10 minutes)
Present an overview of the entire session (Parts One and Two) and have participants select one of the indicated options (see Step 6).

Step 2. (20 minutes)
Distribute Attachment III-20/1-A, "Mid-Cycle and Final Evaluation of Training Goals," and ask participants to complete it.

Step 3. (5 minutes)
Distribute the "Expectations List" from Phase I and Attachment III-20/1-B, "Discussion Questions."

Step 4. (30 minutes)
Have participants form groups of up to five, and:
* Review and discuss the overall program in relation to the discussion questions.
* List on newsprint 4-5 ways in which their expectations have been met and 4-5 ways in which they have not been met.

Step 5. (5 minutes)
Ask each group to return and post their lists at the front of the room.

Step 6. (40 to 60 minutes)
Option A: Have a representative from each group explain and discuss their list.
Option B: Use the lists as a basis for moving into the "Fishbowl" activity described in Phase I: Session 16, Part Three.

MID-CYCLE AND FINAL EVALUATION OF TRAINING GOALS

Rate the effectiveness of the training program in achieving the following goals. Give 2 or 3 specific examples in support of your rating.

	Not very Effective		Adequate		Extremely Effective
1. Assess and analyze community felt needs	1	2	3	4	5
2. Assist others in the design, adaptation, construction, utilization and maintenance of simple technologies	1	2	3	4	5
3. Acquire and apply skills and attitudes that promote the improvement of the quality of life through local initiative, community problem solving	1	2	3	4	5
4. Examine and understand the cultural and societal values that accompany all overseas development workers	1	2	3	4	5
5. Develop and practice effective experiential learning and teaching processes	1	2	3	4	5
6. Understand the synergistic relationship between health and technology and the interrelated nature of all aspects of culture	1	2	3	4	5
7. Encourage and include the active, full participation of all community members in programs of change	1	2	3	4	5
8. Maintain personal well-being and the attitudes conducive to effective and appropriate overseas service	1	2	3	4	5

DISCUSSION QUESTIONS

1. Has the program met expectations?

2. Is the program providing adequate skills training?

3. Is the technical level too high or too low?

4. Could the program be better adapted to suit individual needs?

MID-PROGRAM EVALUATION
PART TWO: ASSESSMENT OF GROUP DYNAMICS

Total time: See Part One

Objective: To evaluate the dynamics of the group within the context of the training program

Resources: Attachment III-20/2, "Coat of Arms"

Materials: List of questions on newsprint (see Step 2)

Procedures: Step 1. (10 minutes)
Review the session objective and procedures. Distribute Attachment III-20/2, "Coat of Arms."

Trainer Notes

Explain that the object of this exercise is to draw a symbolic "Coat of Arms" which represents perceptions of the dynamics of the group within the context of the training program.

Step 2. (10 minutes)
Post and explain the list of questions for the coat of arms.

Trainer Notes

Explain that the participants will draw a symbol in the corresponding spaces on the coat of arms that answers the following questions:

1. What has been our major failure as a group?
2. What has been our major accomplishment as a group?
3. To what extent do our interactions here in training reflect the kinds of interactions we will encounter as Peace Corps Volunteers?
4. What is our major unresolved conflict or problem as a group?
5. What can we do to resolve this conflict or problem?
6. What can we do to improve our interaction skills in general?

Step 3. (20 minutes)
Referring to the posted list, read each question in order, allowing time for people to draw their symbols before moving to the next question.

Trainer Notes

Draw your own coat of arms while the group does theirs.

Step 4. (5 minutes)
After everyone has finished drawing his/her coat of arms, share your coat of arms by explaining the meaning of each of your six drawings.

Step 5. (60 to 60 minutes)
Have each participant explain the meaning of his/her coat of arms.

Trainer Notes

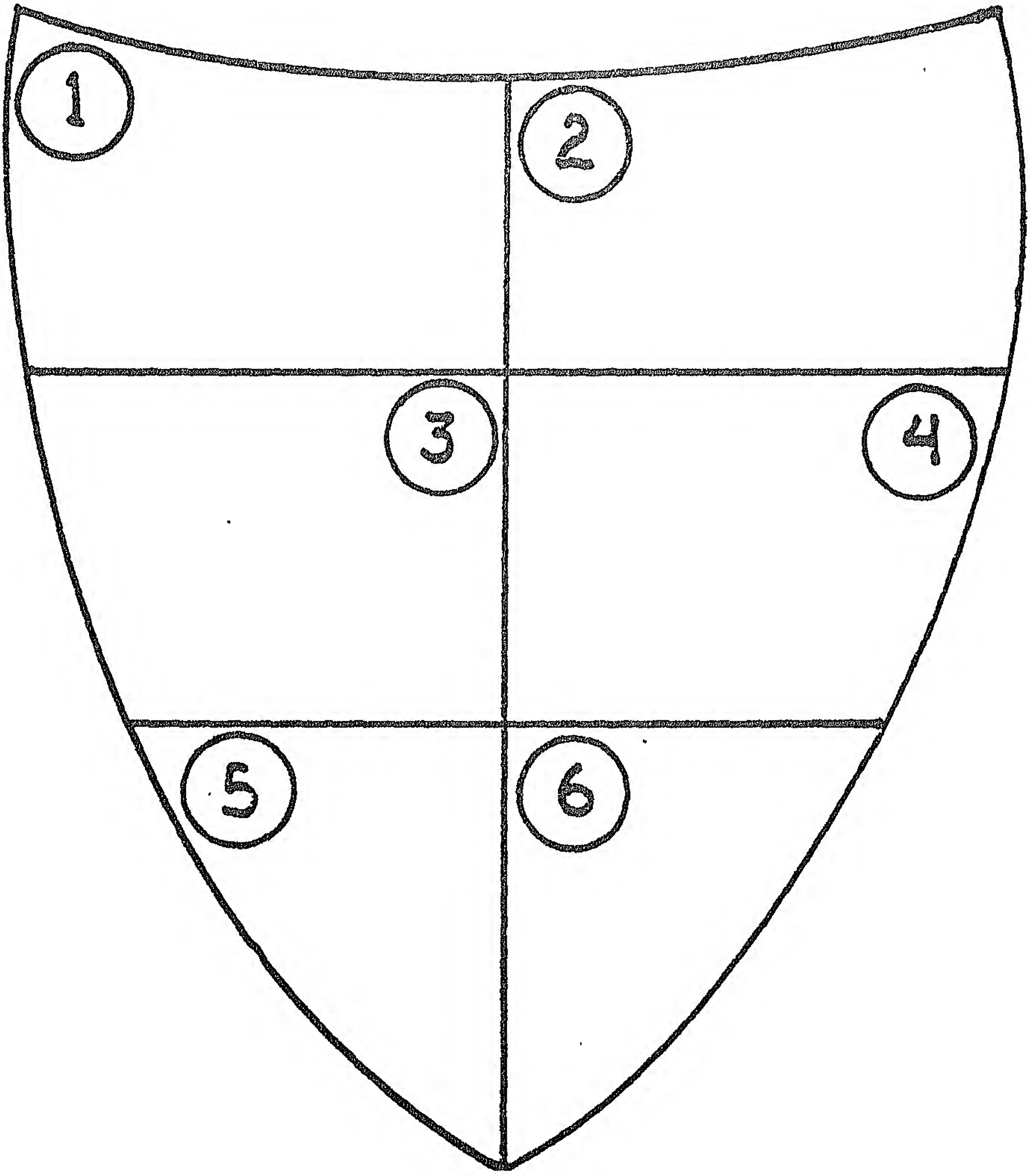
If the group is large (15 or more participants), time limitations may require dividing the group into two or three small groups for this step.

Step 6. (15 minutes)
Conclude the session by having participants summarize the results of the activity, highlighting problems and possible solutions.

Trainer Notes

Time remaining from the scheduled four-hour period can be utilized by moving into the regularly scheduled "Phase Evaluation Questionnaires" or counterpart sessions.

COAT OF ARMS



PHASE IV: SOLAR WATER HEATERS

Health and Nutrition

The Role of the Volunteer in Development

	DAY 1	DAY 2	DAY 3
A.M.	SESSION 1: Role of the Volunteer in Development, Part 2: The Green Revolution (Skill Areas II&III) SESSION 2: Introduction to Solar Water Heaters (I)	SESSION 4: Introduction to Solar Water Heating: Determining Hot Water Demand (I & III) Independent Study	SESSION 7: Demonstration of a Technical Concept (II) SESSION 8: Shade Mapping and Solar Siting (III)
P.M.	SESSION 3: Assessing Community Water Needs and Uses (I)	SESSION 5: Plumbing a Solar Water Heater (III) SESSION 6: Sizing a Solar Water Heater (III)	SESSION 9: Design of Solar Water Heaters (III)

	DAY 4	DAY 5	DAY 6
A.M.	SESSION 10: Construction of Solar Water Heaters (III & IV)	SESSION 11: Multi-Media Standard First Aid (I)	Construction (continued)
P.M.	Construction (continued)		

	DAY 7	DAY 8	DAY 9
A.M.	Construction (continued)	Independent Study SESSION 12: Wind Technology (III)	SESSION 15: Presentation of Solar Water Heaters (V)
P.M.	Construction (continued)	SESSION 13: Volunteer in Development: Part 2, Women in Development (I & III) SESSION 14: House Design in Four Climates (III)	

THE ROLE OF THE VOLUNTEER IN DEVELOPMENT: INTERNATIONAL DEVELOPMENT
PART 2: THE GREEN REVOLUTION: SUCCESSES AND FAILURES

Total time: 2 hours

Trainer Notes

> For session objectives, resources and materials, refer to Part 1 of Phase III: Session 17.

Procedures:

Step 1. (15 minutes)
Have the moderator review the debate procedures and explain the basic ground rules for a debate.

Trainer Notes

The procedures for the debate are as follows:

A. (2-1/2 minutes) Group #1 makes a brief statement of its position.

B. (2-1/2 minutes) Group #2 makes a brief statement of its position.

C. (10 minutes) Group #1 expands its position by stating facts and providing supporting evidence.

D. (10 minutes) Group #2 expands its position by stating facts and providing supporting evidence.

E. (10 minutes) Group #1 directs questions to specified members of Group #2.

F. (10 minutes) Group #2 directs questions to specified members of Group #1.

G. (10 minutes) There is open questioning.

H. (5 minutes) Group #1 delivers final summation of its position.

I. (5 minutes) Group #2 delivers final summation of its position.

J. (15 minutes) Group #3 presents its ideas on steps that could be taken to develop strategies which would best address the needs of developing countries.

Step 2. (80 minutes)
Have the moderator carry out the debate procedures.

Step 3. (25 minutes)
Summarize the session and facilitate a discussion by asking participants if any of their ideas about appropriate strategies for technology transfer were changed or influenced by the debate.

INTRODUCTION TO SOLAR WATER HEATERS

Total time: 2 hours

Objectives:

* To review and discuss various types of solar water heaters
* To explain the basic principles of solar water heating
* To discuss examples of solar water heaters being used throughout the world, especially in developing countries

Resources:

* Zweig, Peter, "Introduction to Solar Water Heaters" Slide Show
* Attachment IV-2-A, "Sunlight and Glazings"
* Attachment IV-2-B, "Typical Thermosiphon Solar Water Heater"
* Attachment IV-2-C, "Lesotho Solar Water Heaters"
* Attachment IV-2-D, "Early Solar Water Heaters"

Materials: Newsprint and felt-tip pens, slide projector, screen

Procedures:

Step 1. (5 minutes)
Review session objectives and outline the activities.

Step 2. (45 minutes)
Distribute and briefly review the attachments (See Resources). Encourage a discussion of the application of solar water heaters in developing countries.

Trainer Notes

Begin the discussion by asking such questions as:

* Why solar? Or, why use solar energy?
* Why is solar energy considered a "second-rate" energy source in some countries?

Continued

Trainer Notes/Continued

* What factors have kept solar energy from being an "appropriate" technology?

* What factors have contributed to its "appropriateness"?

It is more useful to facilitate a discussion of each attachment than to describe each one to the participants. Encourage people to explain the sketches and drawings. If the explanation is incorrect or incomplete, ask for other interpretations as you guide the discussion and help the participants understand the material. Keep the discussion focused and do not spend too much time on any one attachment.

Take the time, however, to make sure that all participants understand the information, since it will be needed during the slide presentation and throughout the phase. Note that some systems shown are plumbed to sinks or showers while others must be filled and emptied daily.

Be sure that the discussion addresses such issues as --

* Plumbed and unplumbed solar water heaters
* Simple solar water heaters vs. large and/or expensive systems
* The needs and uses of hot water
* The participants' own use of hot water
* How that need may change once in the host country

Explain that there are some communities in the world where hot water is not found. No one has ever had hot water there and everything is and always has been done with cold water.

Ask the participants:

* What important information should be obtained before attempting to introduce solar water heaters to a community?

* How could solar water heaters be effectively introduced to a community that has traditionally used only cold water?

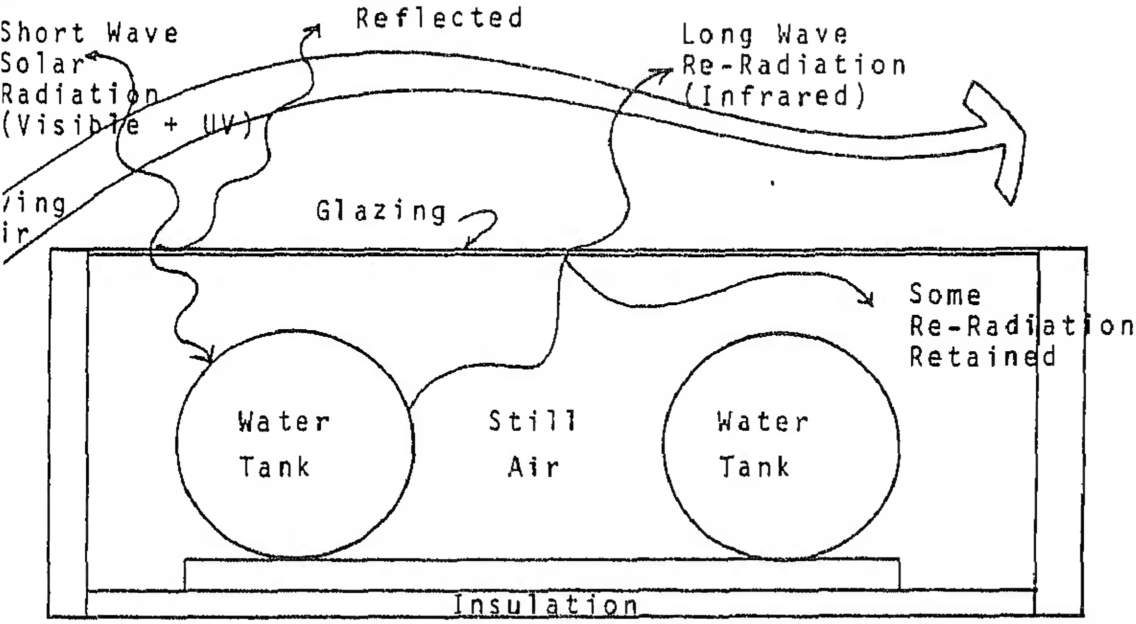
Step 3. (60 minutes)
Present the slide show on solar water heaters, encouraging discussion and questions.

Trainer Notes

Again, as with the session attachments, ask the participants to describe each slide as it is projected. Do not spend too much time on any one slide. Refer to the attachments as necessary. Focus the discussion on the possible utility of the different models in developing countries, how the devices function, what they are made of, their cost, etc.

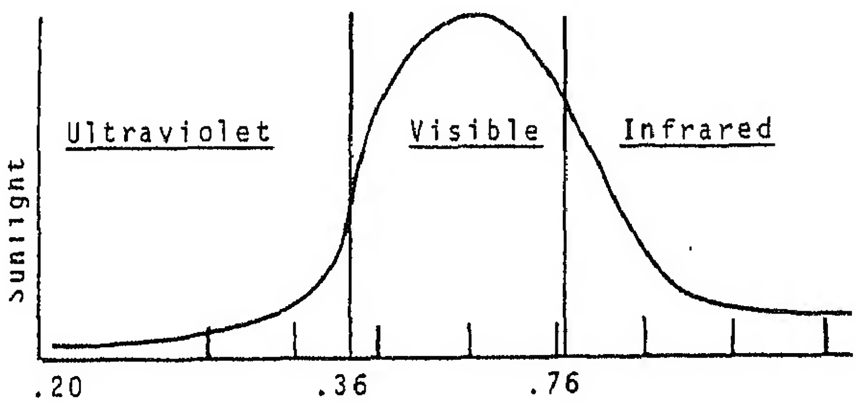
Step 4. (10 minutes)
Conclude the session by asking the participants to identify what they feel are important points to keep in mind when considering the application of solar water heaters in the countries in which they will be serving.

SUNLIGHT AND GLAZINGS

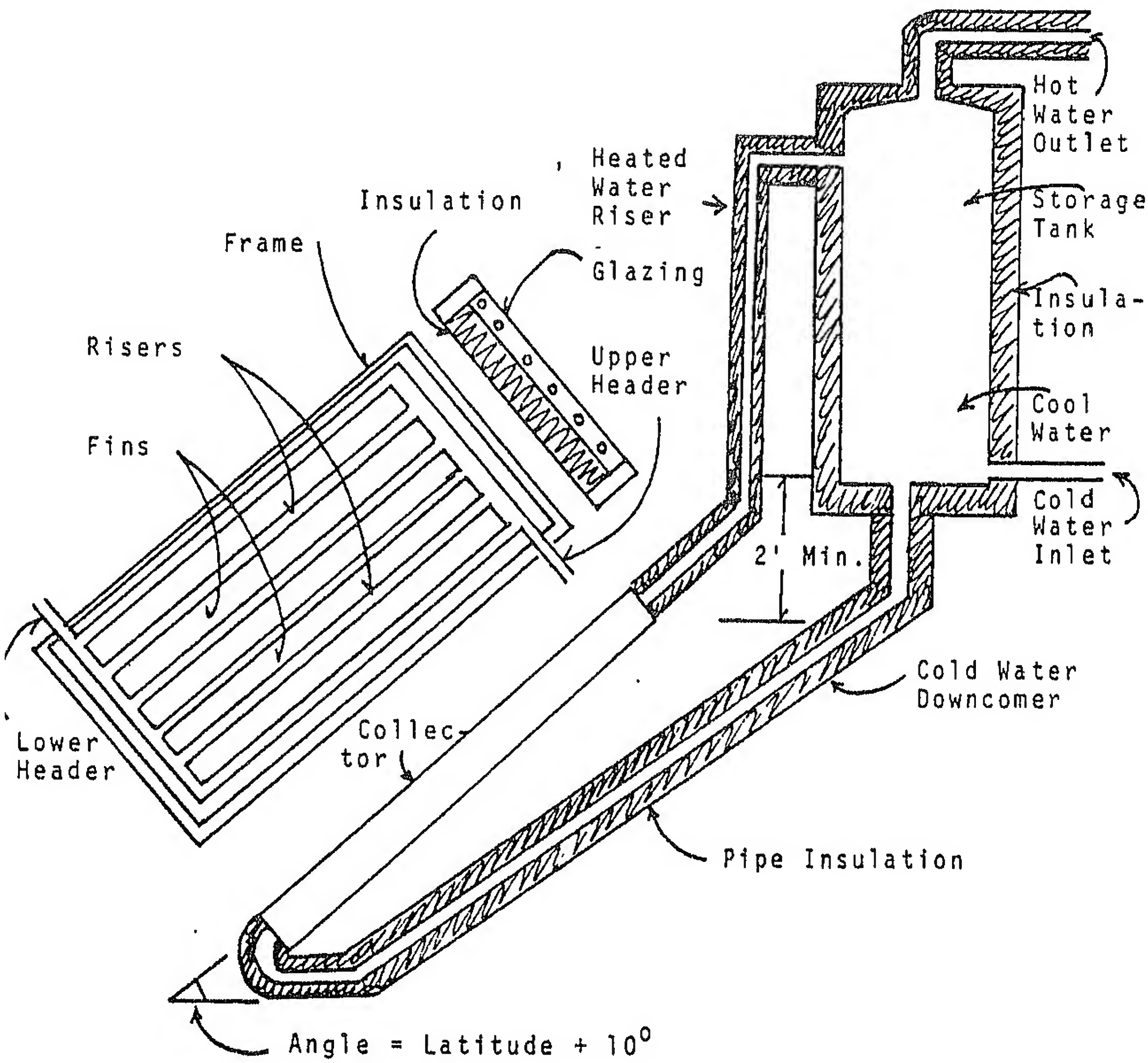


Glazing Material	Short Wave-Length Transmis-sivity	Long Wave-Length Transmis-sivity
Polyethylene	85-95%	85%
Polyvinyl	85-95%	70%
Fiberglass	72-93%	10%
Glass	88-93%	3%

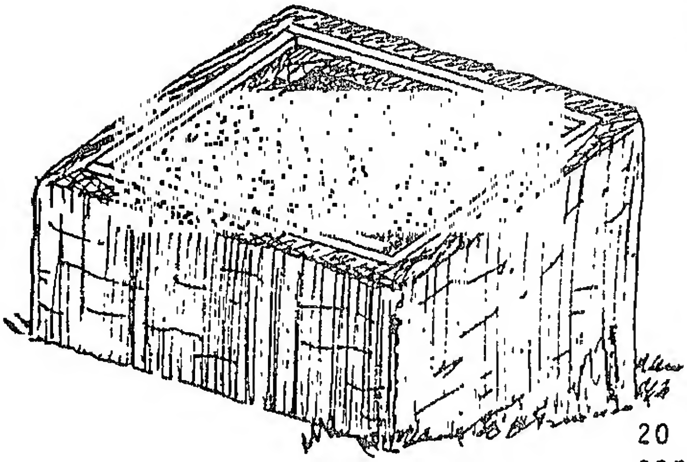
Radiation Wavelength (Micrometers):



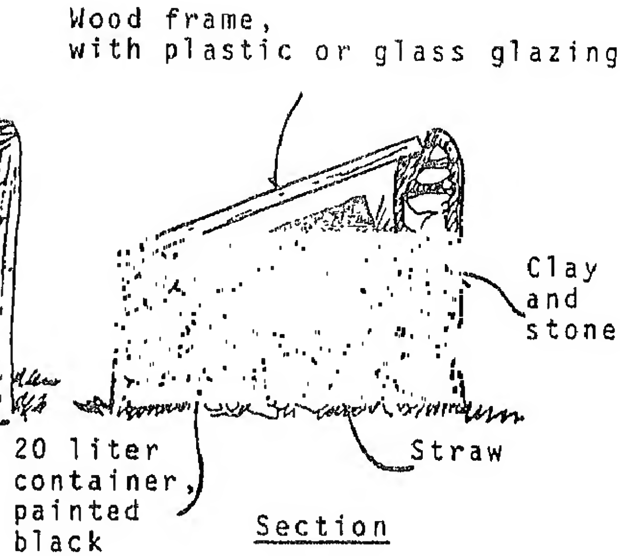
TYPICAL THERMOSIPHON SOLAR WATER HEATER



LESOTHO SOLAR WATER HEATERS



Perspective



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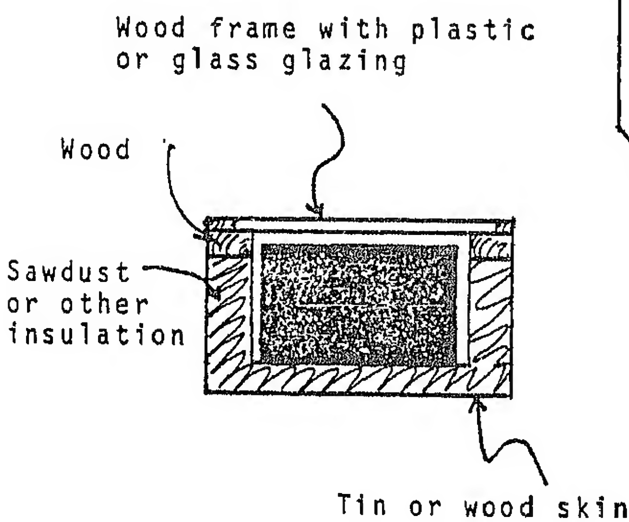

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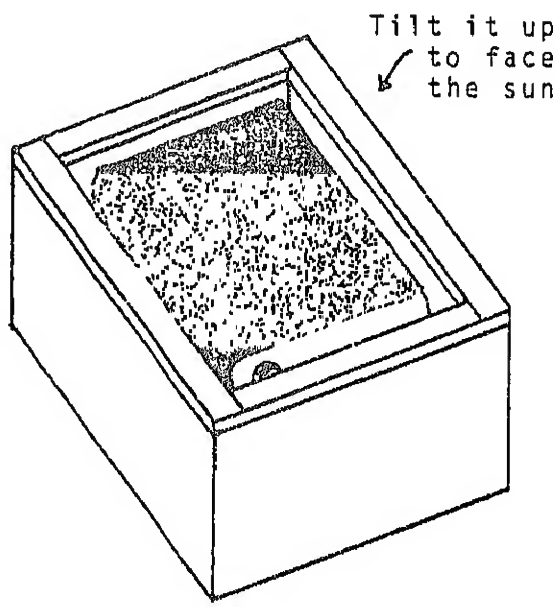
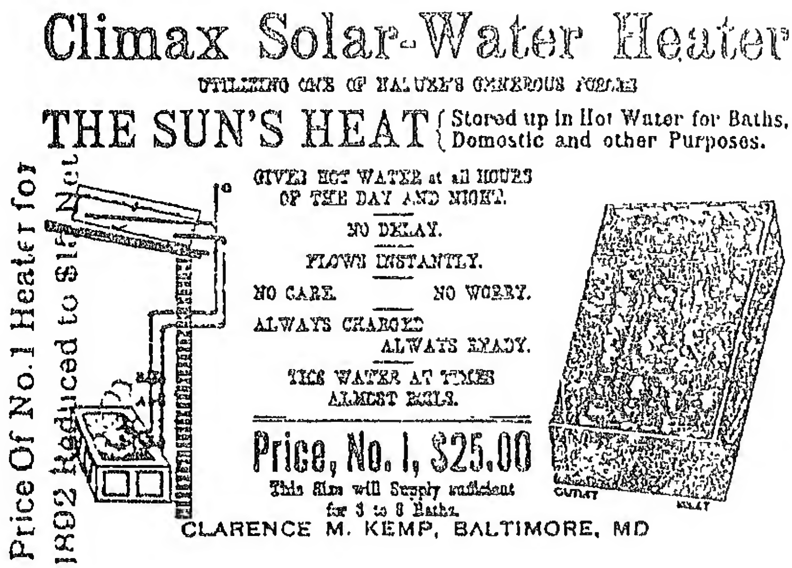


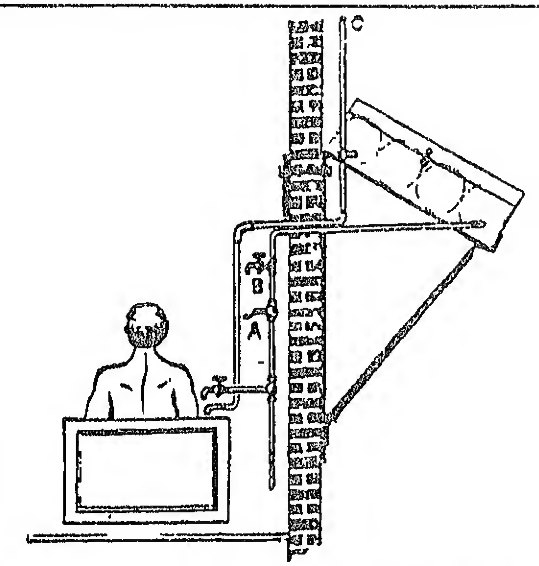
Perspective

EARLY SOLAR WATER HEATERS



Advertisement for the Climax solar water heater, 1892. The price of this, Kemp's smallest unit, had just dropped from $25 to $15.

Below: Two ways to install the Climax, from a company brochure: pressurized system (left), and gravity-fed system (right).

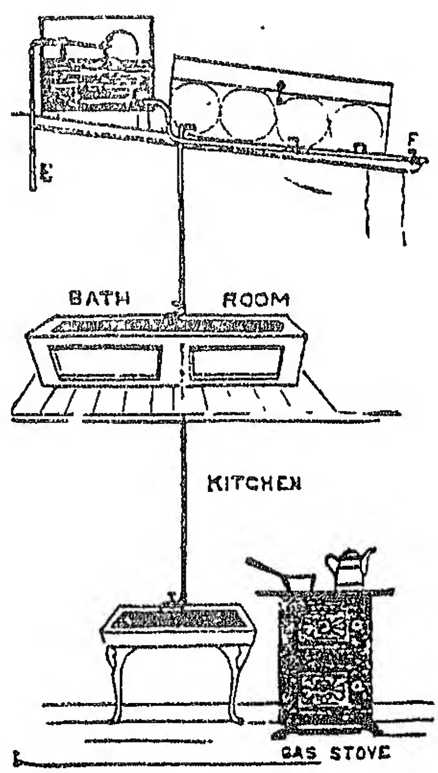


—Shows a Climax Solar-Water Heater supported by a bracket on the wall.

A.—Is the cock to use when the hot water is wanted. This passes cold water into the heater, displacing the hot water and forcing it through a pipe to the bath tub.

B.—Is the drain cock which is used to prevent freezing.

C.—The air opening which prevents vacuum in the heater and siphonic action.



ASSESSING COMMUNITY WATER NEEDS AND USES

Total time: 4 hours

Objectives:

* To develop and use a community water needs assessment form in the evaluation of local water use and requirements

* To discuss the importance of sensitivity to community organization, culture, customs and values

Resources:

* Attachment IV-3-A: "Guidelines for Community Water Needs:

* "Skills for Development Facilitators" from Manual Introduction

Procedures:

Step 1. (10 minutes)
Give an overview of the session and distribute Attachment IV-3-A: "Guidelines for Community Water Assessment Needs."

Step 2. (30 minutes)
Have participants form work groups. Then read and discuss the attachment. Each group should develop a plan to assess the water needs in a local community.

Step 3. (2 hours)
Each group follows the plans they have developed to assess community water needs and uses. Ask them to prepare a brief report of findings and methods.

Step 4. (1 hour)
The groups meet and present their reports.

Trainer Notes

To stimulate discussion, these questions might be raised:

* Why type of assessment was used?

* Why was it selected?

* Was the method effective? How could you tell?

* Were community members receptive?

* What was it like to be in the role of interviewer?

Continued

Trainer Notes/Continued

* How did you know if the sources were reliable?
* Were there any specific customs and/or values which seemed to facilitate/impede the information gathering process?

Step 5. (20 minutes)
Ask participants to review the skills for development facilitators (from the manual introduction) and discuss any correlation between the five skill areas and the procedures involved in this session.

Trainer Notes

You may find it helpful to focus the discussion by emphasizing similarities and/or differences in the sequential order of the skill areas and the procedures of this session.

GUIDELINES FOR COMMUNITY WATER NEEDS/USES ASSESSMENT

In teams of 2 to 4 people, choose an aspect of community life (education, health care, residential, support systems, etc.) and through community assessment techniques (questionnaire, interview, observation, conversation, combinations of a number of methods), gather data about the water requirements and uses in that particular area. The data should include:

* End use of the water
* Amounts and temperatures required at the end use
* Disposal systems for gray and black water (including who is responsible, the specific methods of disposal)
* Description of the water system
* Water sources and methods of storage
* Purification systems
* Health problems associated with the water system

In gathering the information, please follow these guidelines:

* All team members should participate actively in all phases of the exercise.

* Information gathering should be conducted in a sensitive and careful manner.(Always ask permission before entering a place or reading a meter. Be sure you don't prowl around or intrude.)

* Concentrate on using appropriate communication skills: respect your informants' privacy and values, listen and report accurately, be patient, report facts, not what you wish you had found.

* Limit the scope of the report -- or you may be overwhelmed.

Your written report should include:

* A summary of data
* A copy of questions asked
* Methodology used
* Resources consulted during the project
* Suggestions for improving the assessment
* Recommendations to improve existing water systems and health status in ways that are environmentally sound, energy efficient, and within cultural and economic constraints of the community

INTRODUCTION TO SOLAR WATER HEATING: DETERMINING HOT WATER DEMAND

Total time: 2 hours

Objectives:

* To collect and calculate data regarding estimated levels of daily hot water use
* To compare different levels of hot water use in the United States to probable hot water consumption and needs in host countries
* To discuss the possible uses of solar-heated water in host countries

Resources:

* Attachment IV-4-A, "Hot Water Volume and Temperature Data Collection Sheet"
* Design Criteria list from Session 2

Materials: Hot water source and for each group: 1 liter calibrated metric containers, large (8 liter or 2 gallon) wash basins, Celsius thermometers, newsprint and felt-tip pens

Trainer Notes

You may want to select one or two participants to assist as co-facilitators for this session. If so, review the session procedures with them and plan their involvement. Their involvement might include: gathering and distributing materials, facilitation of discussions and assisting the other participants with calculations. If this option is followed, set aside time after the session for feedback on their facilitation skills.

Procedures:

Step 1. (10 minutes)
Post the session objectives and briefly outline the activities.

Step 2. (10 minutes)
Have participants review the list of design criteria for solar hot water devices developed during Session 2.

Trainer Notes

Try to generate new ideas for additions or modifications to the list.

It is important that the criteria list include: inlet temperature, insolation rate, percent possible sunshine and efficiencies and volumes.

Step 3. (5 minutes)
Note the criteria that are related to water temperature, volume, use and the kind of consumer and explain that the session's activities will focus on these areas.

Step 4. (5 minutes)
List three categories of consumers: heavy, light and low (or non-users).

Trainer Notes

Ask for examples in each category:
* Heavy: industrial use, convenience-oriented urban family
* Light: conservation-minded family, etc.
* Low: poor rural family, backpacking, etc.

Point out that there will be overlap in each category.

Step 5. (5 minutes)
Distribute Attachment IV-4-A, "Hot Water Volume Temperature Data Collection Sheet." Explain the data collection activity and have participants form work groups of 2 or 3.

Trainer Notes

* Explain that each work group will select a consumer type from one of the categories listed and collect data on the estimated amount of hot water used per day by the hypothetical user.
* Data should be collected in at least three areas (e.g., hand-washing, dishwashing, bathing, etc.). Post the instructions to help clarify the activity.
* Questions about the data collection procedure will probably arise (e.g., "Do we have to take a shower and collect the water?"). Explain that where possible, people should collect the water as it is used. If it is not feasible, as in the case of a shower, an estimate of the water needed should be made.
* Be sure there is no confusion on how to fill out the data collection sheet.
* At this point, a co-facilitator/s may assist work groups who need clarification.

Step 6. (45 minutes)
Have work groups collect and calculate data.

Step 7. (10 minutes)
Reconvene the large group and have a representative from each work group report their findings and discuss methods used to obtain the data.

Step 8. (20 minutes)
Facilitate a discussion of water use customs and patterns in host countries as compared with the United States.

Trainer Notes

For reference during this discussion, post the following information about average consumption of hot water in the U. S.:

* Heavy consumer: 60 - 80 liters per day
* Light or conserving consumer: 30 - 50 liters per day
* Host country person: 0 - 80 liters per day

You should provide further focus for this discussion by asking and/or posting on newsprint the following questions:

* How do water consumption rates and patterns in host countries compare with those of the U. S.?

* In rural villages in which there has never been hot water, will there be a need or desire for hot water?

* What are some specific, potential uses for solar water heating devices in host countries?

Step 9. (10 minutes)
Explain that the information presented and ideas generated during this session will be used in conjunction with the data on insolation and climate to develop a sizing formula for use in the design of solar devices.

Explain that the information and ideas will also apply to the selection and design of solar-heated devices during this training program.

HOT WATER VOLUME AND TEMPERATURE DATA COLLECTION SHEET

Step 1:
Fill out the following chart for one person's daily hot water use, recording the actual volume and temperature data where you can and estimating where you need to do so. Decide among the group whether your measurements and estimates are for a non-conserving person, a conserving person, a city-dweller, a rural person, a camper, etc.

Hot Water Use	Volume Per Day $\left(\frac{\text{Liters}}{\text{Day}}\right)$			Temperature (^{o}C)		
	Min.	Max.	Avg.	Min.	Max.	Avg.
Hands						
Dish wash & rinse						
Sponge bath						
Shower						
Clothes wash & rinse						
Other						
Other						
TOTAL AVERAGE VOLUME PER PERSON PER DAY				MAX. TEMP:		

Step 2:
Decide how many people are in your hypothetical family of conservers, non-conservers, campers, etc. Multiply the total average volume per person per day times the number of people in the family to find out the average daily family hot water usage (given in liters per day):

Total average volume per person per day ( ) Liters/Person Day

X Number of people in the family x(___) Persons

= Average daily family hot water use ( ) Liters/Day

NOTE: This information will be used in Session 6: Sizing a Solar Water Heater

PLUMBING A SOLAR WATER HEATER

Total time: 2 hours

Objectives:

* To identify plumbing fittings and their uses
* To identify plumbing tools such as pipe wrenches, pipe vise, cutter and threaders
* To demonstrate the mechanisms for galvanized pipe cutting and threading
* To cement PVC (poly vinyl chloride) pipe and fittings together such that no leaks occur
* To diagram a plumbing schematic of a solar water heater

Resources:

* Attachment IV-5-A, "Plumbing Fitting Nomenclature"
* Attachment IV-5-B, "Plumbing Schematics Worksheet"
* Attachment IV-5-C, "Plumbing Solar Water Heaters"
* Bainbridge, The Integral Passive Solar Water Heater Book
* Anderson, The Solar Home Book, pp. 209-226
* VITA, Village Technology Handbook, pp. 86-91
* Burton, "Integral Passive Solar Water Heater Plans"

Materials: A variety of plumbing fittings (nipples, elbows, tees, 45's, couplings, unions, lock nuts, adapters, etc.) in 12 and 18 mm (1/2" and 3/4") galvanized iron, and PVC pipes, gate and globe valves, hose clamps, pipe vise, pipe wrenches, pipe cutter, pipe reamer, pipe threader, threading oil, threading compound, PVC solvent, PVC primer

Procedures:

Step 1. (5 minutes)
Present the session objectives and outline the activities.

Step 2. (20 minutes)
Distribute Attachment IV-5-A, "Plumbing Fitting Nomenclature," Spread the assortment of galvanized and PVC plumbing fittings on a large table and have the participants identify and discuss the use of each fitting.

Trainer Notes

Allow a few minutes for small groups to assemble five to ten fittings with the understanding that each small group will then name each fitting in the assembly, from end to end, with help from the group as needed. Or, hold up each fitting, piece by piece, and ask the group to name it.

Explain that it is important during training to know plumbing terminology or nomenclature in order to:

* Complete the plumbing schematic worksheet (See Step 6)
* Complete the solar water heater plumbing schematic and parts list to be developed during the design session
* Be more clear during construction when one member of the small construction group is sent to get a "1/2" whatchama-callit" from the shop
* Better understand any new names for fittings which may exist in the participant's country of assignment

Be certain that this step includes a discussion of how and when a pipe union should be used.

Step 3. (15 minutes)
Demonstrate and describe the cutting, reaming and threading of galvanized pipe using the appropriate tools.

Trainer Notes

You may choose to ask for volunteers with plumbing experience to demonstrate to the rest of the group how galvanized pipe is cut, reamed and threaded. Be certain that the volunteer is complete in his/her description. Include proper tool use instructions as needed, especially with the cutter, the pipe vise, pipe wrenches, reamer and pipe oil.

Step 4. (10 minutes)
Demonstrate and describe the joining of galvanized pipe using pipe wrenches and pipe joint compound.

Trainer Notes

Again, ask for volunteers from the group to demonstrate.

Mention the different pipe joint compounds used throughout the world, including oil, oiled rope or twine (China), lead rope, teflon rope, etc.

Continued

Trainer Notes/Continued

Describe the use of pipe wrenches (i.e., two are needed at one time, how they automatically ratchet, the proper way to hold, adjust, and use a pipe wrench, etc.).

Explain that pipe joint compound is placed only on the male threads of the pipe joint so that the compound is evenly spread over the threads as the fitting is tightened.

Step 5. (15 minutes)
Demonstrate and describe the joining of PVC pipe and fittings, using primer and/or solvent.

Trainer Notes

Ask for volunteers from the group to demonstrate this step.

Point out that:

* Solvent is placed on the male part only for small size pipe (12 and 18 mm) but for large pipe it is O.K. to use solvent on both ends. If solvent is used on the female end, it may form a bubble and seal off the smaller sized pipes as the two pieces are pressed together. With large pipe, this is less likely to happen.

* The two pieces need to be twisted together and held still for a few seconds to keep them together.

* PVC fittings are not re-usable.

Describe the process that the solvent goes through to "melt" a thin layer of pipe and fitting together to form the seal.

Discuss the usefulness of PVC pipe in solar water heaters, since it cannot take very high temperatures and it doesn't transfer heat well.

Step 6. (20 minutes)
Distribute Attachments IV-5-B and IV-5-C and have the participants complete the plumbing schematic of the solar water heater shown in Attachment IV-5-B.

Trainer Notes

Allow the participants to work individually or in groups of two to complete the schematic. Explain that the answers are partially described in Attachment IV-5-C. Remind them to label all parts, including pipe size,type, fittings, valves, etc. Remind them of the use of unions in plumbing.

Step 7. (20 minutes)
Have each individual or small group describe and explain their plumbing schematic to the group.

Trainer Notes

Be sure the criteria on the worksheet are addressed by each presentation.

After the first or second description, ask for any new or different schematics.

At the end of the presentations, briefly identify and discuss inexpensive and effective plumbing shortcuts:

* Explain how a tee-with-a-plug can replace a more expensive drain valve at the bottom of each tank.

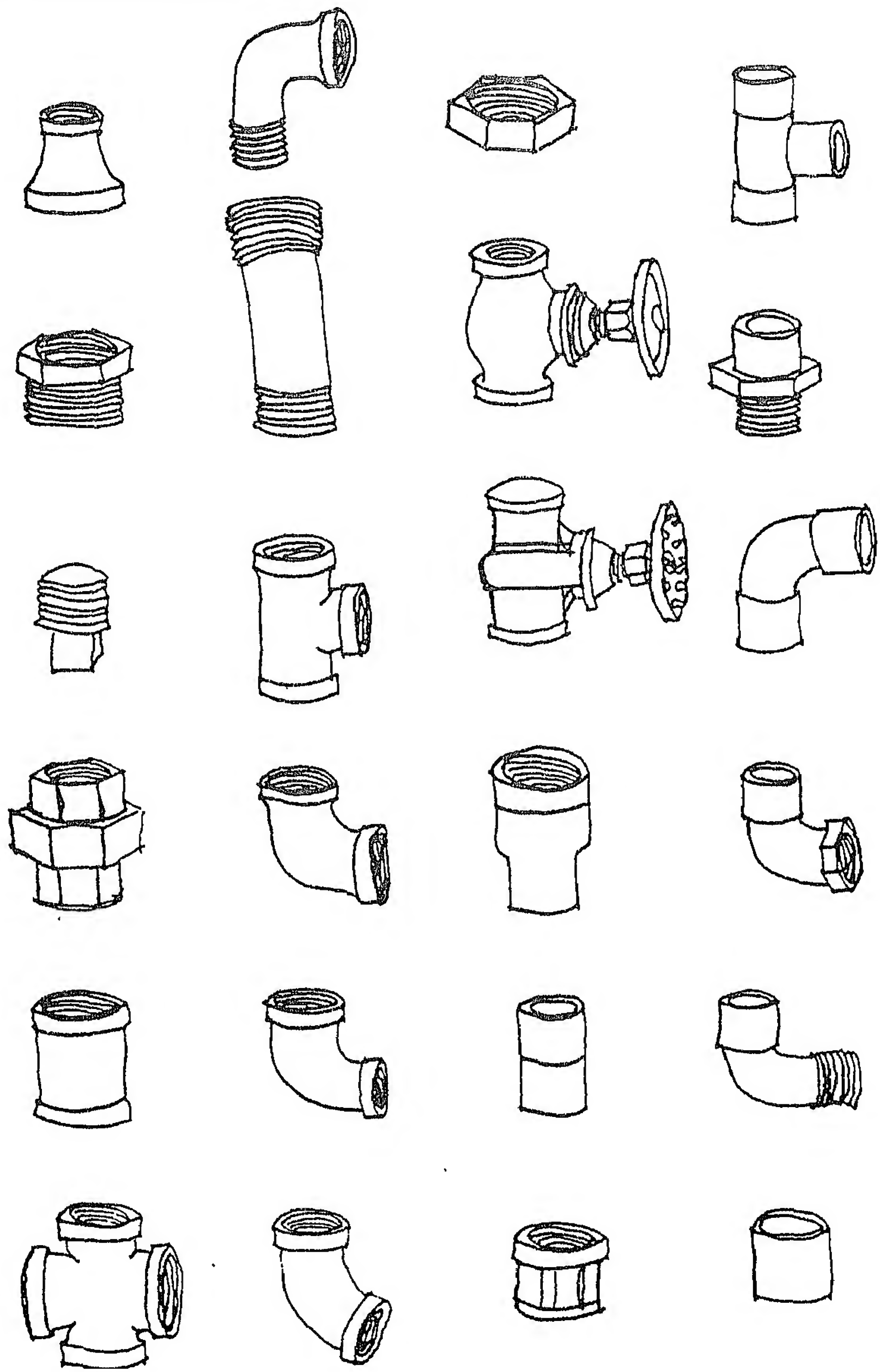
* Ask how a mixing valve could be manufactured from scratch, using only one union (one tee, two valves and some nipples).

Step 8. (15 minutes)
Conclude the session with a brief discussion of plumbed vs. unplumbed solar water heaters, their advantages and disadvantages, and their applications in countries in which participants will be serving.

Trainer Notes

Allow time at the end of the session for cleanup and dismantling of any plumbing that was constructed during the session.

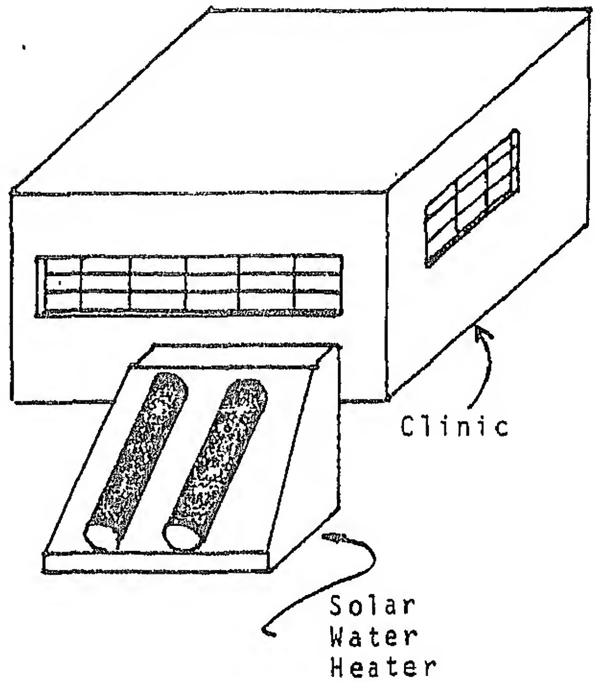
PLUMBING FITTING NOMENCLATURE



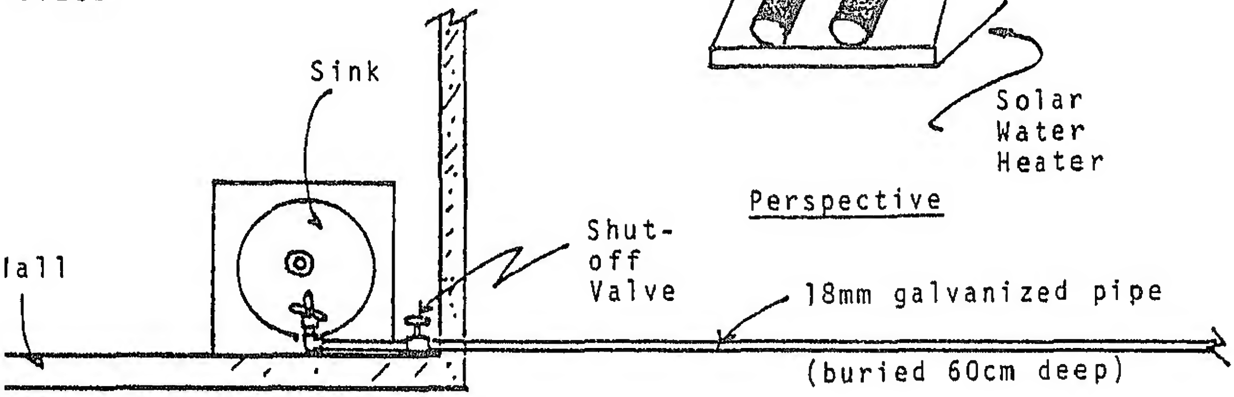
ıBING SCHEMATIC WORKSHEET

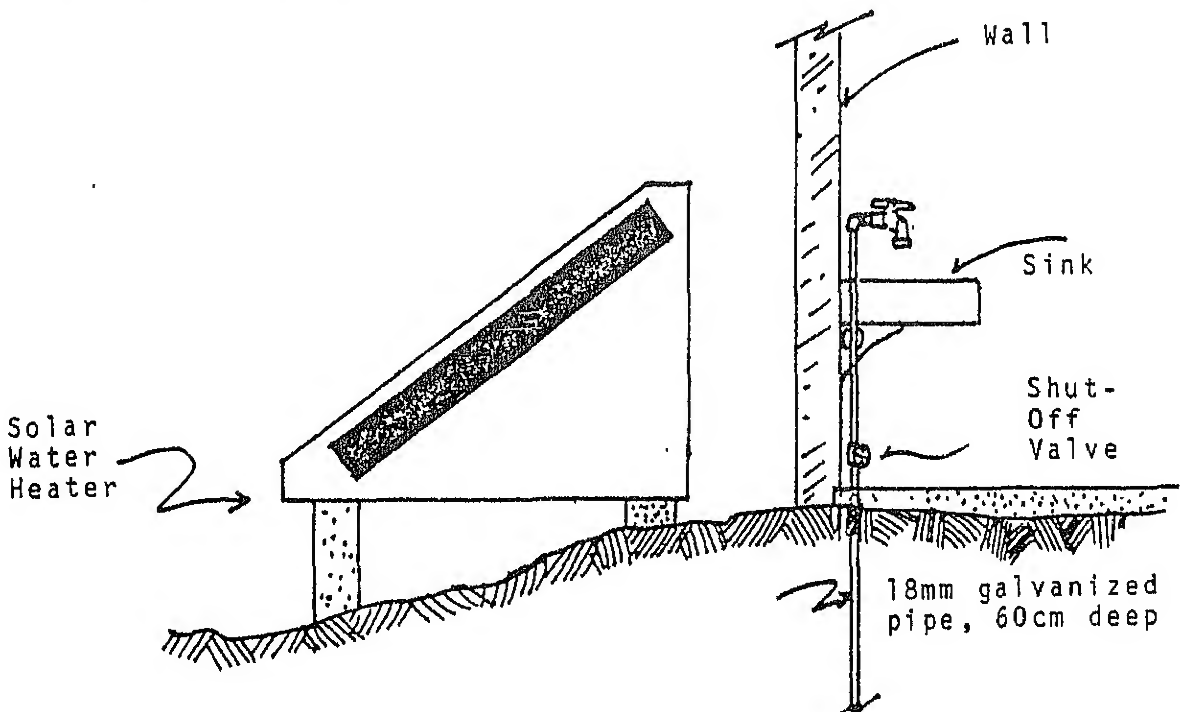
:ctions:

; clinic originally had only
ı water at the sink inside.
have just finished building
rect-gain solar water heater
the clinic and you need to
ıb: (1) cold water to the
ır heater and the sink, and
hot water to the sink.
as few parts as necessary
·educe costs. Design a mix-
valve to be used at the sink.
valves and unions where needed.
ɜl all pipe and fitting names
sizes.



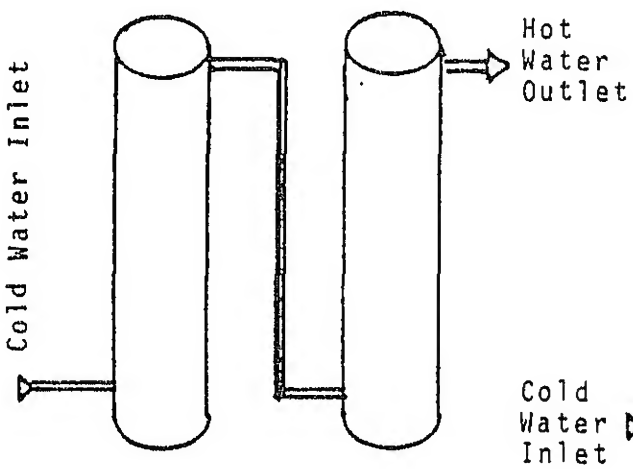
Perspective



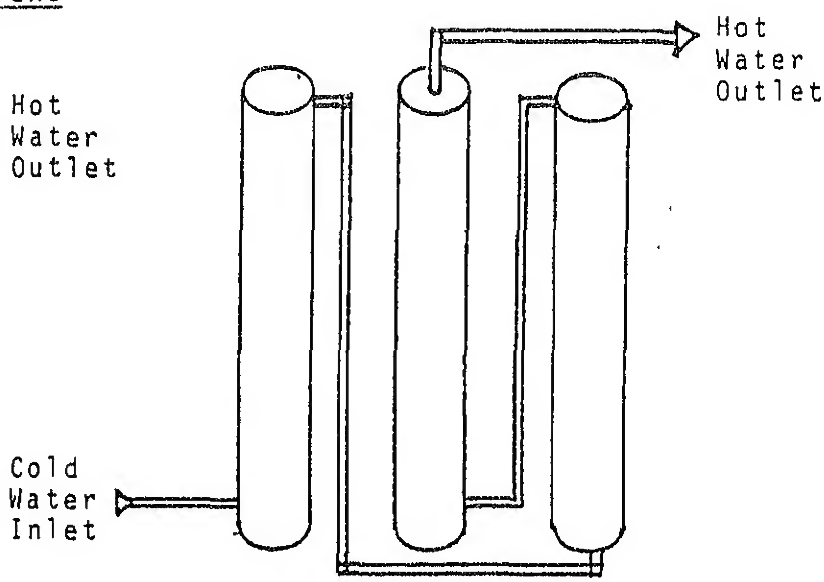


Section

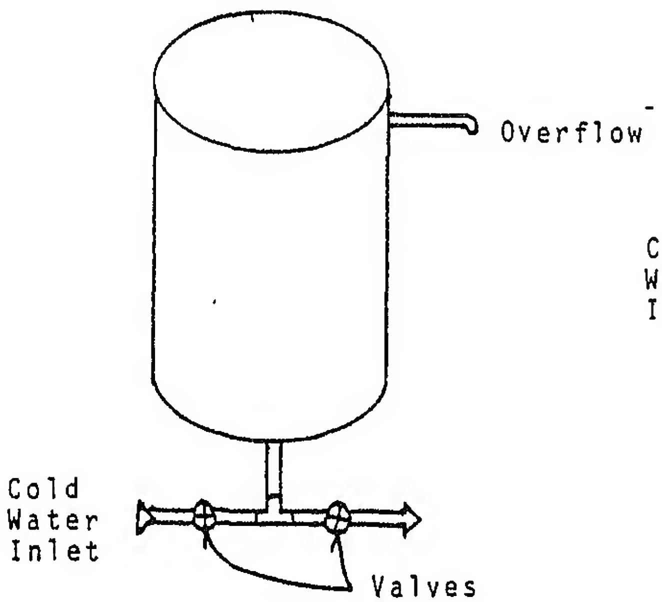
PLUMBING SOLAR WATER HEATERS



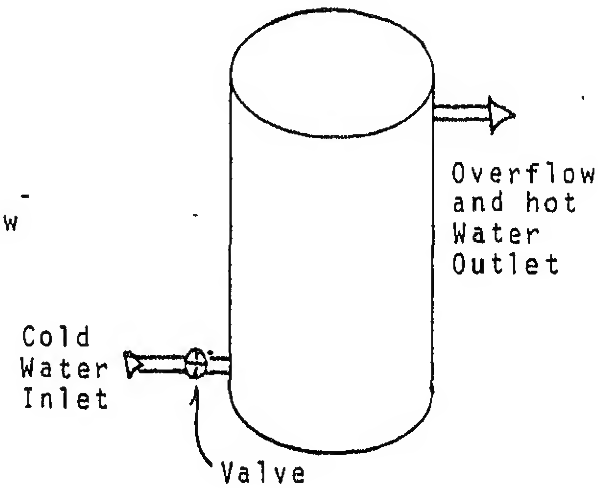
A two-tank, pressurized solar water heater system.



A three-tank, pressurized, solar water heater system.



A one-tank, non-pressurized solar water heater system with mixing valves.



A one-tank, non-pressurized "overflow" solar water heater system.

SIZING A SOLAR WATER HEATER

Total time: 2 hours

Objectives:

* To use and discuss the solar water heating sizing formula and sizing rule of thumb
* To review and discuss the relationships between insolation, collector area, storage size and hot water demand
* To correctly orient a solar water heater
* To discuss how to pressure test a plumbing system

Resources:

* Attachment IV-6-A, "Rules of Thumb: Sizing a Solar Water Heater"
* Attachment IV-6-B, "Rules of Thumb: Orienting a Solar Water Heater"
* Attachment IV-6-C, "How to Size a Flat Plate Collector"
* Attachment IV-6-D, "How to Pressure Test a Plumbing System"
* Attachment IV-6-E, "Direct Gain Sizing Problems"
* Attachment IV-6-F, "Flat Plate Sizing Problems"

Materials: Newsprint and felt-tip pens

Trainer Notes

This session will require considerable preparation as you will need to make copies of each of the attachments and have them ready for distribution during the session.

Step 1. (5 minutes)
Post the objectives, outline and explain the session activities.

Trainer Notes

* It is helpful for one or more of the participants to volunteer to describe each attachment to the rest of the group as it is distributed.
* Encourage group discussion of each attachment and add your comments if the information offered by the volunteer is incomplete or inaccurate.

Continued

Trainer Notes/Continued

* Discuss each of the following questions completely to be certain that every participant understands the principles of each attachment.

* Encourage those who understand the principles to work with those who are having difficulty.

Step 2. (10 minutes)
Distribute, review and discuss Attachment IV-6-A, "Rules of Thumb: Sizing a Solar Water Heater."

Trainer Notes

To stimulate the discussion:

* Ask for the difference between a direct gain and a thermosiphon solar water heater.

* Ask for the sizing ratio of one group's insolation meter.

It is appropriate here to explain the difference between a "rule of thumb" and a formula and that the reason for having "rules of thumb" is that they are more easily understood by people with no technical background.

Step 3. (10 minutes)
Distribute, review and discuss Attachment IV-6-B, "Rules of Thumb: Orienting a Solar Water Heater."

Trainer Notes

Since most countries in which the PCVs will serve are within 15° of the equator, it is important that the participants use the sun charts or sun angle calculator from Phase III: Session 2, "The Path of the Sun," to describe the sun's path at or near the equator.

To stimulate and guide the discussion:

* Ask for the orientation of the tilt of a solar water heater if :

  1. You are on the equator, it rains every afternoon, every morning is clear and hot water is needed year-around.

  2. You are 15° south of the equator and only need hot water from September through March.

  3. You are 15° north of the equator, it rains every morning, the afternoons are clear and you need hot water year-around.

Step 4. (10 minutes)
Distribute, review and discuss Attachment IV-6-C, "How to Size a Flat Plate Collector."

Trainer Notes

Explain that the variables in each step of the attachment can have an effect on the size of the collector needed: if hot water usage doubles, the collector area and tank volume will have to double. If the number of people using the hot water doubles, then the collector area and storage tank volume will have to double, and so on.

Here are some sample discussion questions:

* Does each variable have a direct relationship to the collector area and storage tank volume (as in the examples given above) or an inverse relationship to the area and volume (i.e., if the insolation rate mysteriously doubles, the collector area and storage tank volume can be cut in half)?

* How important is "percent possible sunshine" to the equation?

* What do you think is the range of collector efficiencies?

* How can you determine the insolation rate for your own microclimate?

Be certain that each participant understands the logic behind the calculations, even if they don't understand the math.

Point out that Step 4 of this attachment leaves us with an area-to-volume ratio which is described as a rule of thumb in Attachment IV-6-A.

Step 5. (10 minutes)
Distribute, review and discuss Attachment IV-6-D, "How to Pressure Test a Plumbing System."

Trainer Notes

Allow time for everyone to read the attachment. Refer to the last session, Plumbing a Solar Water Heater, and discuss any questions about the attachment.

Step 6. (30 minutes)
Distribute and review Attachment IV-6-E and have the participants complete the problems. When they have finished, have them share and discuss their answers.

Trainer Notes

One option during this and other such exercises is to encourage people to work together, in groups of two or three. Although it is not the traditional way of taking a quiz or test, it does promote cooperation and learning and reduces frustration and unnecessary competition for "the best grade."

During the discussion of the answers, explain that:

* Direct gain solar water heaters work best when the desired final temperature is not above 55°C (130°F).

* Plumbed water heaters should have at least two tanks to reduce mixing of hot and cold water.

Step 7. (30 minutes)
Distribute and review Attachment IV-6-F and have the participants complete the problems. When they have finished, have them share and discuss their answers.

Trainer Notes

Remind the participants that they can use either the sizing formula or the sizing rule of thumb in this activity. During the discussion of the answers, note any difference between using the sizing formula and the rule of thumb.

Step 8. (15 minutes)
Conclude the session by reviewing the various methods used to size solar water heaters.

Trainer Notes

Explain that the participants will have an opportunity to apply the information from this session during the design and construction of solar water heaters.

Encourage any questions, comments or discussion.

RULES OF THUMB: SIZING A SOLAR WATER HEATER

Direct Gain Solar Water Heaters

Direct gain solar water heaters are usually sized at 80 liters of water storage for every square meter of collector aperture or area. This ratio of 80:1 will provide hot water (55°C or 130°F) in the afternoon of sunny, warm days if the tank is filled with cold water (15°C or 60°F) in the morning.

If this ratio is changed to 40 liters of water for every square meter of collector (40:1), then the water will heat up faster but will also cool off faster in the afternoon or at night if the tanks are not insulated.

If this ratio is changed to 120:1, the water will barely get warm (38°C or 100°F) but will retain its heat for many hours. This ratio is best used to pre-heat water which will be heated to a higher degree with another heat source. This is the most cost-effective ratio but provides the least hot water.

Flat Plate Collector Solar Water Heaters

The 80:1 ratio also holds true for flat plate collector solar water heaters. Flat plate collector systems, however, have the advantage that the solar heated water is stored in an insulated container so it is less likely to cool down in the afternoon or at night.

Ratios approaching 40:1 tend to be less cost effective. Since it is the collector that determines the total cost of the system, more collector with less storage will cost more and provide you with less hot water.

Ratios approaching 120:1 are more cost effective but will not heat water as hot as an 80:1 ratio system. A system with a ratio of 120:1 will warm the water most of the year, heat it up very well a few months of the year, but will need to be supplemented with another water heater to get hot water (55°C or 130°F) for most sunny and warm months of the year.

Experimenting

Build a solar water heater or an insolation meter when you get to your country and change the storage tank-to-collector aperture ratio to find which ratio will work best for you in your microclimate.

RULES OF THUMB: ORIENTING A SOLAR WATER HEATER

In North America, a common rule of thumb for orienting a solar water heater is to face it within 45° of true south (with true south being the optimal direction) at a tilt of "latitude plus 10 degrees." The Continental United States includes latitudes from 25° to 48°. Therefore, tilt angles can vary from 35° to nearly 60° from the horizontal.

As solar collectors approach the equator, orientation and tilt become more seasonal because the sun moves into both the north and south hemispheres during the course of the year. Therefore, orientation depends on when the solar energy is needed (which months) and the local microclimate (i.e., are there clear mornings or clear afternoons during the months when the solar energy is needed?). If a solar collector is on the equator and facing south with a tilt of 15° from the horizontal, it will work well during the months of September through March. However, from March until September, the sun will be behind the collector. If a solar collector is facing east with a tilt of 15°, it will collect well only during the morning hours. This orientation is best for locations with cloudy and/or rainy afternoons.

The best tilt for a solar collector on the equator is no tilt at all: a horizontal collector. This causes problems, however, with naturally circulating systems such as food dryers and thermosiphon water heaters: the air or water doesn't know which way to flow; it doesn't know which way is up. As soon as you tilt and orient a collector, it will only work half of the day or year.

Therefore, the tilt and orientation of a solar collector near the equator depends on what time of year the solar energy is needed and what part of the day is sunniest in the microclimate of the collector.

The orientation of a solar collector in the Southern Hemisphere should be toward the north, toward the equator. The tilt of the collector should be the same as for a Northern Hemisphere collector -- latitude plus 10°.

HOW TO SIZE A FLAT PLATE COLLECTOR

To properly design and construct a passive solar water heater, one needs to know the amount of energy required in the form of heated water and the amount of sunlight available on an average day during the time of least sunshine.

By simply dividing the energy required per day by the energy available per day per area, one can determine the area of collector aperture needed.

1. How much energy is required?

   Find: Average hot water usage per person per day

   Number of people using hot water per day

   Desired temperature of hot water

   Incoming cold water temperature

   Density of water (weight per volume)

   For example: 40 liters hot water per person per day
   3 people per day
   45 degrees C desired hot water temperature
   15 degrees C incoming water temperature
   Density of water is 1 Kg/liter

$$\frac{40 \text{ liters}}{\text{person day}} \times 3 \text{ people} \times (45\text{-}15^{\circ}C) \times \frac{1 \text{ kg}}{\text{liter}} = 3600 \frac{Kg^{\circ}C}{\text{day}}$$

$$3600 \frac{Kg^{\circ}C}{\text{day}} \times 1 \frac{\text{Kgcal}}{Kg^{\circ}C} = 3600 \frac{\text{Kgcal}}{\text{day}} \quad \text{(energy required)}$$

2. How much energy is available?

   Find: Clear day winter insolation for the desired tilt

   Percent possible sunshine

   Collector system efficiency

   For example: 2700 Kgcal/m^2 day
   65% possible sunshine
   40% system efficiency

$$2700 \frac{\text{Kgcal}}{m^2\text{day}} \times .65 \times .40 = 700 \frac{\text{Kgcal}}{m^2\text{day}} \quad \text{(energy available)}$$

3. By dividing the amount of energy required (Step 1) by the amount of energy available (Step 2) one can get a very good approximation of the collector aperture required to provide the desired temperature and volume of water on an average day during the period of least sunshine.

For example:

$$\frac{3600 \ \frac{\text{Kgcal}}{\text{day}}}{700 \ \frac{\text{Kgcal}}{\text{m}^2\text{day}}} = 3600 \ \frac{\text{Kgcal}}{\text{day}} \times \frac{\text{m}^2 \ \text{day}}{700 \ \text{Kgcal}} = 5.1 \ \text{m}^2$$

5.1 m^2 of collector aperture is needed to provide 120 liters of water at 45°C if the incoming water is at 15°C and the insolation is 2700 Kgcal/m^2 day.

(Notice how a complex fraction -- a fraction over a fraction -- can be simplified by "inverting and multiplying." Also note how the units will always cross out to leave just the units needed: in this case, square meters, or m^2.)

4. Once this ratio of aperture-to-volume is found, it can be used to size a collector for any size hot water tank, assuming all of the variables remain the same.

If the system will not be asked to provide hot water during the period of least sunshine (if, for example, there is virtually no sun for six months of the year), the clear day <u>summer</u> insolation for the desired tilt and the <u>summer</u> percent possible sunshine must be substituted for the winter data used in Step 2. Summertime system efficiency is also much greater than wintertime efficiency because there is less heat loss in the summer.

Care must be taken not to ask too much of a solar collector system: If a system is sized to provide hot water in the winter, it will probably produce very hot water in the summer, which is potentially dangerous (scalding occurs at water temperatures of 60°C).

HOW TO PRESSURE TEST A PLUMBING SYSTEM

1. To pressure test with water only:

   Cap or plug all openings in the system, except two. Of these two, loosely cap or plug one of them and attach a garden hose or some other water source to the other. Make sure that the loosely capped or plugged opening is near the top of the system.

   Begin filling the system. When water begins to leak from the loosely capped or plugged opening, tighten the cap or plug so that no water can escape. Inspect all joints in the system for leaks by looking for obvious ones and feeling each joint for any sign of moisture. Mark any leaky joints. Drain the system, fix the leaks and re-test.

2. To pressure test with water and compressed air:

   Cap or plug all but one opening near the top of the system. Fill the system with water using this upper opening. Attach a compressed air source to the system and compress to 50 pounds per square inch (3.5 Kg/cm^2) pressure or to the pressure at which the system will be operating, whichever is greater. Tap each joint with a wooden or rubber mallet to simulate expansion and contraction stresses. Look for water leaks at each joint. Mark all leaks, drain the system, repair the leaks and re-test. (If a pressure gauge is available, attach it to the system and test for 24 hours.)

3. To pressure test with air only:

   Cap or plug all but one opening of the system. Attach the pressure gauge tester to the remaining opening and compress with air to 50 psi or 3.5 Kg/cm^2 or the pressure at which the system will be operating, whichever is greater. Tap all joints with a wooden mallet to simulate expansion and contraction stresses. Listen for leaks. Leave the gauge on the system for at least 24 hours. If the gauge shows ANY decrease in pressure, there is a leak in the system. Leaks can be found by applying a soap-and-water solution to each joint and watching for bubble formations. Mark any leaks. Release the pressure from the system, fix the leaks and re-test.

DIRECT GAIN SIZING PROBLEMS

Given the following information, decide whether or not a direct gain solar water heater will be effective and, if so, find the number and size of tanks needed and the aperture needed to raise the water to the desired temperature.

Daily hot water volume requirement (liters)	80	200	240	300	400
Desired outlet temperature (0° C)	50	65	40	45	70
Inlet temperature (0° C)	15	20	20	15	20
Insolation available ($\frac{\text{Kgcal}}{m^2 \text{day}}$)	2300	3000	2700	2500	2250
Will a direct gain solar water heater be effective? (Yes / No)	____	____	____	____	____
Number and size of tanks	____	____	____	____	____
Aperture area (m^2)	____	____	____	____	____

FLAT PLATE SIZING PROBLEMS

Given the following data, determine the size of storage tank and area of collector required. Assume a 50% efficiency on the collector.

Hot water volume requirement (liters/day)	100	120	40	200	20
Desired hot outlet temperature (0^{o} C)	40	50	55	60	35
Inlet water temperature (0^{o} C)	15	20	15	20	15
Insolation rate ($\frac{Kgcal}{M^2 day}$)	2700	2500	2000	3000	2250
Percent possible sunshine (%)	75%	70%	65%	60%	50%
Size of tank(s)	____	____	____	____	____
Area of flat plate collector (m^2)	____	____	____	____	____

DEMONSTRATING A TECHNICAL CONCEPT

Total time: 2 hours

Objectives:

* To practice explaining, demonstrating and and transferring technical information
* To identify and discuss effective communication techniques involved in transferring technical information

Resources:

* Attachment IV-7-A, "Role Play Descriptions"
* Fuglesang, Applied Communication in Developing Countries
* Hall, Beyond Culture

Materials: Newsprint and felt-tip pens, hot plate and tea kettle (or coffee percolator or other steam source), .1m^2 (1 ft.^{2}) sheet of glass

Trainer Notes

This session will require considerable advance planning, study and preparation. You should familiarize yourself well with the procedures before beginning the session. Also, all the role play descriptions from Attachment IV-7-A should be read, cut out and organized for distribution in advance.

In this session, there are a total of six role play situations: three in which participants play PCVs and three in which they play villagers. Each participant will play the PCV role once and the villager role twice.

There will be one presentation done by each of the three PCV role play groups. While the first PCV role play group is doing its presentation, all the other participants will play the first villager role described in the attachment (Part II). Then, while the second PCV role play group is doing its presentation, all other participants will role play the second villager role. And, finally, while the third PCV role play group is doing its presentation, all other participants will take the third villager role.

Step 1. (5 minutes)
Briefly present the session objectives and review the procedures.

Step 2. (10 minutes)
Have the participants divide into three groups and distribute the three PCV role play descriptions from Part I of the attachment.

Trainer Notes

* Distribute to each PCV group the "General Role Description."

* Distribute to PCV role play Group #1 the first "Specific Role Description."

* Distribute to PCV role play Groups #2 and #3 the second and third "Specific Role Descriptions" respectively.

* Give newsprint and felt-tip pens to PCV Groups #2 and #3.

* Give the glass and steam source to PCV Group #3.

Step 3. (25 minutes)
Have each PCV role play group prepare its presentation based on the information provided by the role descriptions.

Step 4. (10 minutes)
Reconvene all the participants and ask PCV role Group #1 to set up their presentation as you distribute and explain the First Villager role description (from Part II of the attachment) to all of the other participants.

Trainer Notes

Explain that while PCV role play Group #1 is doing their presentation, all other participants will be role playing villagers as described in the First Villager role description.

Step 5. (15 minutes)
Have PCV role play Group #1 do their presentation.

Step 6. (5 minutes)
Have PCV role play Group #2 set up their presentation as you distribute and explain the Second Villager role description (from Part II of the attachment) to all of the other participants.

Trainer Notes

Explain that while PCV role play Group #2 is doing their presentation, all other participants will be role playing villagers as described in the Second Villager role description.

Step 7. (15 minutes)
Have PCV role play Group #2 do their presentation.

Step 8. (5 minutes)
Have PCV role play Group #3 set up their presentation as you distribute and explain the Third Villager role description (from Part II of the attachment) to all of the other participants.

Trainer Notes

Explain that while PCV role play Group #3 is doing their presentation, all other participants will be role playing villagers as described in the Third Villager role description.

Step 9. (15 minutes)
Have PCV role play Group #3 do their presentation.

Step 10. (15 minutes)
Have all the participants regroup and discuss the effectiveness of each role play presentation.

Trainer Notes

* Encourage the participants to generalize about effective or ineffective communication techniques used during the presentations.

* As an aid to discussion, post the following:

  I hear, I forget; I see, I remember; I do, I understand.

  -Confucius-

* Mention that the use of all the senses is the best way to learn.

ROLE PLAY DESCRIPTIONS

Part I: PCV Role Descriptions

General Role Description to be distributed to every member of each PCV role play group.

You are PCVs in a small village in rural Africa where historically a high infant mortality rate has been experienced which has been attributed to amoeboic dysentary caused by unsanitary water. The youngest son of the village chief contracted this disease and recently died.

Concerned villagers, especially the chief, have asked you and your group to discuss ways of solving this problem. Your job, should you choose to accept it, is to explain the concepts of evaporation/condensation as they apply to solar stills and clean water.

* * *

Specific Role Descriptions to be distributed to group members only.

--------------------------- Cut Here ---------------------------

PCV Group #1: This culture does not permit use of gestures outside of the immediate family and does not appreciate material from outside of the immediate family nor any material from outside the village used for communication. Therefore, no visual aids or props can be used.

--------------------------- Cut Here ---------------------------

PCV Group #2: This village has a high degree of appreciation for non-verbal communication based upon designs and figures used in weaving. It is considered impolite for a non-villager to make speeches. Therefore, you may not as an individual speak more than two sentences at a time. Posters that you have previously drawn showing vectors of fly-borne disease have had a great impact in raising village consciousness.

--------------------------- Cut Here ---------------------------

PCV Group #3: In the past, this village has had limited exposure to Westerners and ideas of the West, so that there is understanding of visual symbols, pictures, alphabets and advertising. Local crafts are important to village life and skills are taught by elder craftsmen to young boys by apprenticeship. These young boys learn by doing.

ROLE PLAY DESCRIPTIONS

Part II: Villager Role Descriptions

---------------------------- Cut Here ----------------------------

First Villager: You are concerned about children dying, disapprove of gestures. You have a tradition of listening politely to and being cooperative with strangers. You are a dignified, serious and industrious people.

(Distribute to PCV Groups #2 and #3)

---------------------------- Cut Here ----------------------------

Second Villager: You are concerned about children dying, appreciate visual representations, do not like strangers to talk too much (it is improper for strangers to speak more than two sentences at a time). You have a tradition of listening politely to and being cooperative with strangers. You are a dignified, serious and industrious people.

(Distribute to PCV Groups #1 and #3)

---------------------------- Cut Here ----------------------------

Third Villager: You are concerned about the death of your children. You have little patience with listening to the expression of new ideas. You are anxious to learn by doing. You have a tradition of listening politely to and being cooperative with strangers. You are a dignified, serious and industrious people.

(Distribute to PCV Groups #1 and #2)

SHADE MAPPING AND SOLAR SITING

Total time: 2 hours

Objectives:
* To develop a shade map for solar site
* To determine a good solar site

Resources:
* Mazria, The Passive Solar Energy Book, pp. 325-327
* Attachment IV-8-A, "Plotting Azimuth and Altitude"
* Attachment IV-8-B, "Shade Mapping Worksheet"

Materials: Directional compasses, protractors, string, plumb bobs (such as 12mm nuts, rocks, etc.), newsprint and felt-tip pens

Procedures:

Step 1. (5 minutes)
List the objectives and outline the session activities.

Step 2. (10 minutes)
Distribute Attachments IV-8-A and IV-8-B to each participant and explain them briefly.

Step 3. (40 minutes)
Have the participants form their solar work groups and develop a shade map for a potential solar site as shown in Attachment IV-8-A.

Trainer Notes

* Distribute one directional compass, protractor, string and plumb bob to each group.
* Circulate among the groups to see that everyone understands shade mapping. Offer assistance as needed. Be sure each group has its compass set properly, as shown in Attachment IV-8-A.

Step 4. (30 minutes)
Reconvene the groups and analyze the sun charts by having participants share and discuss their findings.

Trainer Notes

* Demonstrate that a shade map can be analyzed by overlaying a sun chart with the shade mapping worksheet (Attachment IV-8-B) and looking through them toward a light source, such as the sun. If obstacles show above any of the sun paths, the potential solar site will be shaded at that time of year and that time of day. If the shading is or will be substantial, another site will have to be found.

* Have each group describe their potential solar site and their analysis of that site.

* Ask what range of azimuths need to be considered for possible shading problems at the training site.

* Ask where the "solar window" is on the sun chart.

Step 5. (20 minutes)
Have the groups develop another shade map.

Trainer Notes

* Participants can be given the choice of developing a shade map for either a hypothetical site on the equator or a site in the country in which they will be serving.

* Encourage different people to do the siting and recording so that all of the group members get practice and understand the process.

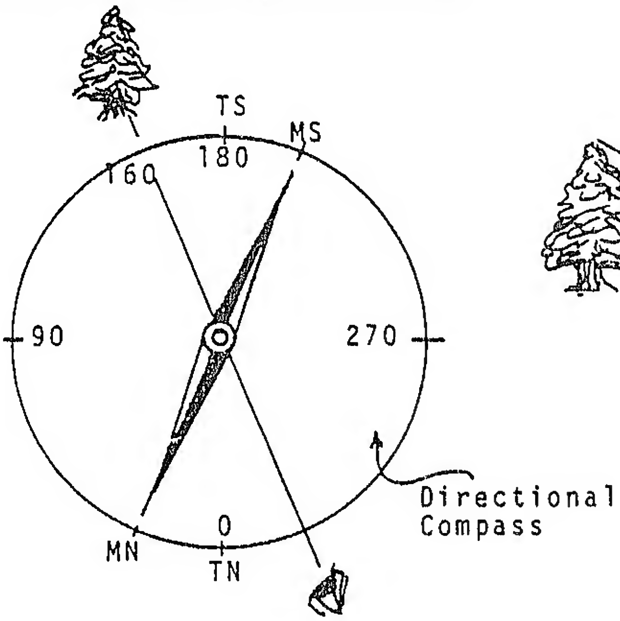
Step 6. (20 minutes)
Reconvene the groups and discuss the findings.

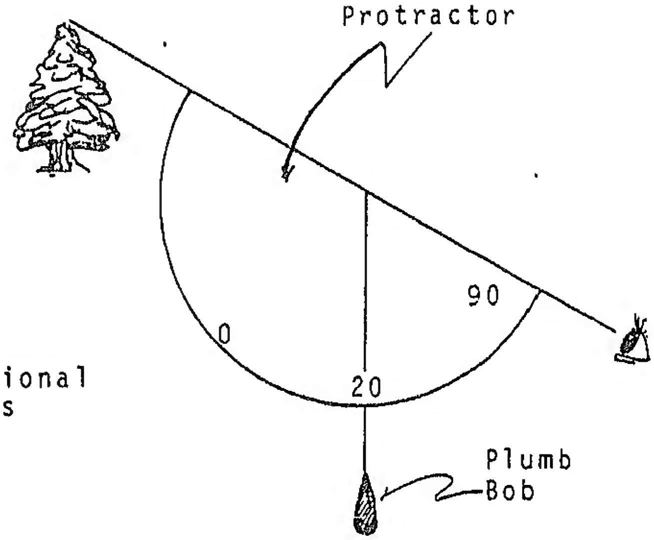
Trainer Notes

* Ask what range of azimuths need to be considered on the equator or in the host countries.

* Explain that the solar sites located by the groups during this session can be used as locations for their solar collectors during the next two phases.

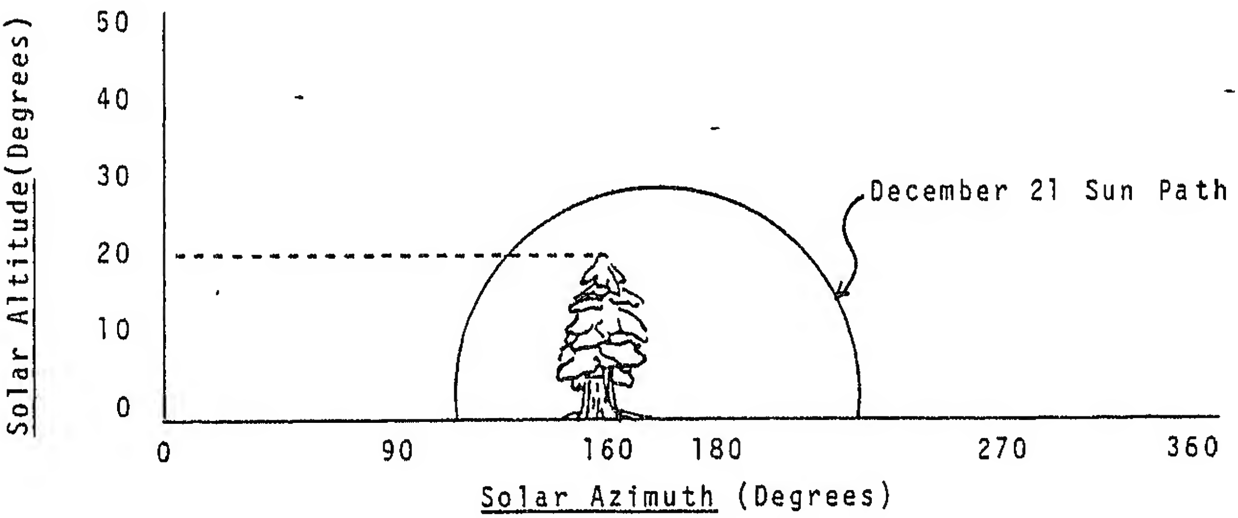
* Mention that the groups have the option of designing solar collectors for the training site or for their host country (if they're not the same) since the orientation and tilt may be different.





Step 1 Find the azimuth of the obstacle (tree) by lining up your eye, the center or the compass and the obstacle. Be sure the compass is corrected for magnetic variation. Read the azimuth of the obstacle, 160° in this example.

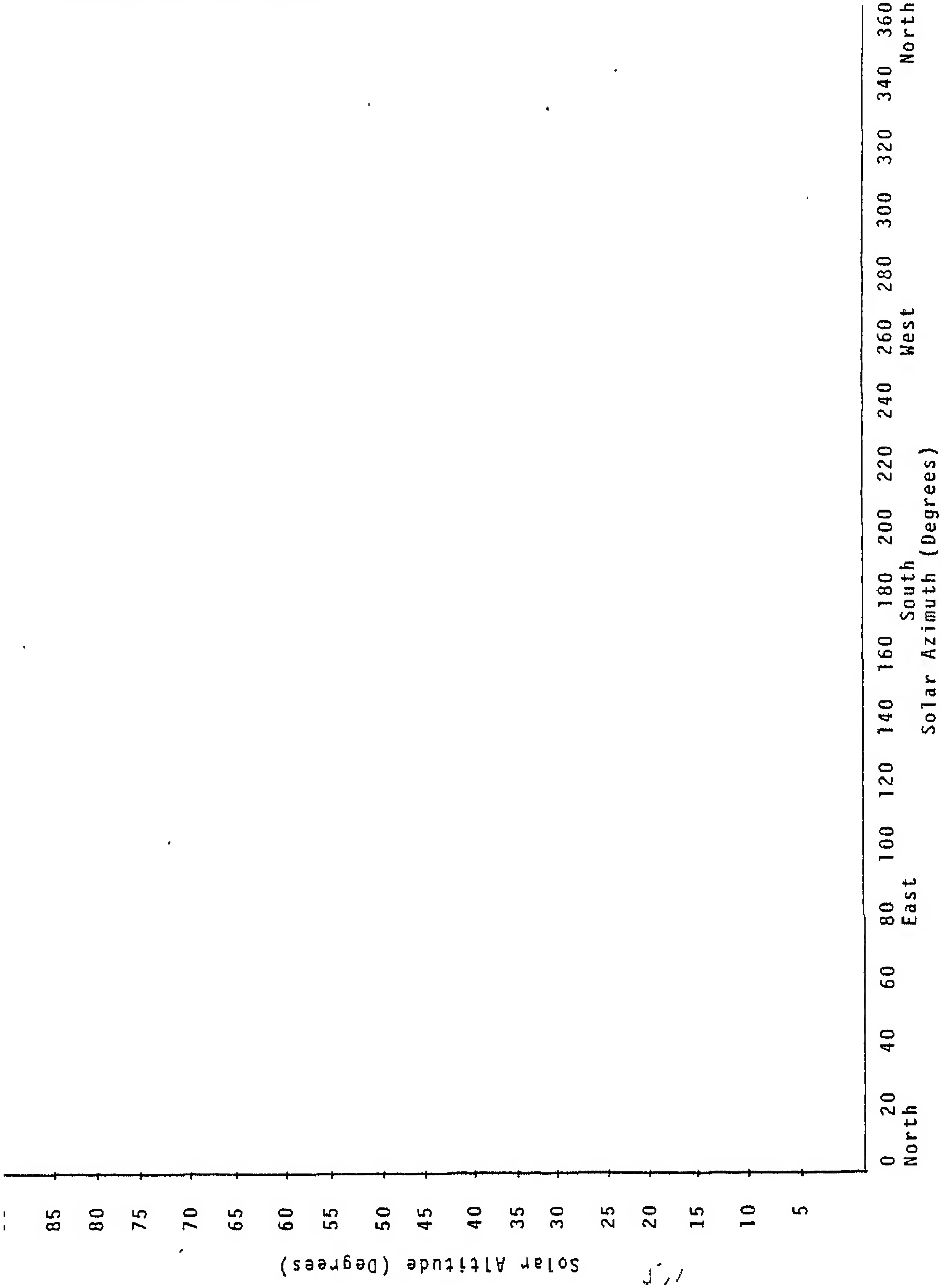
Step 2 Find the altitude by lining up your eye with the top of the obstacle along the straight edge of the protractor. The plumb bob will register the altitude, 20° in this example.



Step 3 Plot the azimuth (160° from Step 1) and the altitude (20° from Step 2) on the shade mapping worksheet as shown. If the December 21 sun path does not cross the image of the obstacle (tree), the obstacle will not shade the collector at this solar site.

Step 4 Locate all possible obstacles and plot them on the shade mapping worksheet. Analyze the data to determine if the potential solar site is actually a good solar site.

SHADE MAPPING WORKSHEET



DESIGN OF SOLAR WATER HEATERS

Total time: 4 hours

Objectives:
* To design a solar water heater
* To examine group dynamics and discuss decision-making styles

Resources:
* Burton, "Vertical and Horizontal Passive Solar Water Heater Plans"
* Baer, "Pro and Breadbox Solar Water Heater Plans"

Trainer Notes

The above resources should be available for use in this session.

Materials: Notebooks, pens, pencils, newsprint, felt-tip pens, drawing paper, T-squares, rulers, etc.

Procedures: Step 1. (5 minutes)
Present the objectives and describe the session activities.

Step 2. (3 hours)
Have the participants form work groups, decide on a solar water heater design and develop a complete set of plans.

Trainer Notes

* Explain that each group should begin the design process by identifying criteria for their solar water heaters. Criteria could be: low cost, simplicity, use of available materials, use of hand tools, durability (5 years), easily built and understood by non-technical people, etc.
* Explain that their plans should include: a materials list, a tools list, an estimated cost and a design drawing.
* Explain that one way for the group to decide on a design is to have each member of the group sketch as many solar water heaters as possible on notebook paper, then pick one sketch from the pile that best fits the group's criteria.
* Remind the participants that they will have only 20 hours to build and test their solar water heater, so the design should not be too complex.

Continued

Trainer Notes/Continued

* Mention that before construction can begin, each design must be checked for completeness and simplicity by the trainer and that the plans should include materials and tools lists.

* Explain that during this process, the group members should observe the group's decision-making styles since it will be discussed later in this session.

* Circulate among the small groups and offer your assistance. Do not force your ideas on the group. Encourage and support their design.

* An option here is to show the groups the copies of the solar water heater plans (from the Resources) to serve as a reference to the work they have done.

Step 3. (30 minutes)
Reconvene the groups and have them present their design criteria and their plans. Encourage questions, comments and discussion.

Trainer Notes

* As the groups are presenting their designs, provide any necessary suggestions for improving feasibility, completeness and simplicity.

* Remind the groups that you will be reviewing their plans in more detail before they begin construction.

Step 4. (20 minutes)
Review and discuss the dynamics of each construction group.

Trainer Notes

The following questions will stimulate and focus the discussion of each group:

* Who did what in the group during the design portion of the session?
* How were decisions made?
* How well did the group function?
* How were problems resolved?

For more detailed information regarding group decision-making styles, refer to Phase I: Session 12, "Earthen Block Molds."

Step 5. (5 minutes)
Briefly review the session and conclude by explaining that the next session will involve the construction of solar water heaters using the plans developed during this session.

CONSTRUCTION OF SOLAR WATER HEATERS

Total time: 20 hours

Objectives:
* To use various tools in the construction of solar water heaters
* To build, monitor and assess a solar water heater
* To recognize and solve problems within the construction group
* To develop and present a complete explanation of the solar water heater

Resources: Attachment IV-10-A, "Monitoring and Assessing a Solar Water Heater"

Materials: Various size and shape water containers, from 4 liters (1 gallon) to 64 liters (16 gallons), flat black paint, sheet metal (aluminum, steel), wood (various sizes and lengths of dimensional lumber, plywood, etc.), sheet plastic, sheet vinyl, glass panes, insulation materials (straw, newspaper, cardboard, etc.), assorted and various tools (saws, shears, paint brushes, hammers, screwdrivers, putty knives, pencils, squares, nails, screws, bolts, pipe wrenches, pipe cutter, pipe vise, pipe threader, thread-sealing compound, pipe-threading oil, various lengths of pipe (12 and 18 mm I.D. galvanized and PVC plastic) and fittings (elbows, tees, couplings, valves, lock nuts, etc.).

Procedures:

Trainer Notes

This 20-hour session allows much latitude for individual trainer styles. It follows a format similar to the construction session for pedal/treadle power in Phase III. The following notes are here to give you some guidance and share some experiences that have worked well during past training programs.

The session does not have to happen all at once. Since it is a 20-hour session, it should be complimented with other sessions, such as Health and Nutrition, the Role of the Volunteer in Development and other Core Technology sessions (See Phase calendar). It is helpful, in fact, to spread the construction time over as many days as possible, because the participants will then have more "spare time" to discuss their projects and their problems outside of session time. A four-hour session, however, should be considered a minimum, since tools and materials have to be set up and cleaned up. Six or eight hours of the day gives

Continued

Trainer Notes/Continued

the participants plenty of time.

Construction naturally follows design. Those groups with complete water heater plans (design drawings, materials lists, tool lists, etc.) should proceed with construction without waiting for the other groups. Therefore, some groups may begin slightly sooner than other groups.

Step 1. (Approximately 16 hours)
Have participants form construction groups and construct, test, modify and evaluate their solar water heater. Distribute and explain Attachment IV-10-A to help the participants with their assessment.

Trainer Notes

At the beginning of each construction period, have the participants discuss the events of the preceding day. Focus the discussions on the group dynamics and problem-solving methods that are being used by each group, what's working and what's not working, etc. This should take 15-25 minutes, depending on how many issues need to be brought up.

Remind the participants of how many hours remain in the construction part of the phase and that some time near the end of the phase should be spent on the development of a presentation for their device. When time begins to get short, encourage the participants to focus on the essential tasks only and to split them among group members to help speed up the process.

During the construction periods, you should keep in touch with how the groups are proceeding, taking time when necessary to show people how to properly use and care for tools.

Don't intervene every time the group or an individual makes a mistake. Mistakes are an important part of the learning process. Intervene only if the safety of the group is in danger or if a certain decision will prove fruitless and take a large amount of time away from the group.

Explain that any group that finishes one project may go on with another small project or begin preparations for the presentation of their device or do research on other types of solar construction.

Allow 10-20 minutes at the end of each construction period for cleanup of the work site and shop area.

Continued

Trainer Notes/Continued

At the end of the final construction session, plan about a half-an-hour for a thorough cleanup of the work site and shop area.

Step 2. (Approximately 4 hours)
Have the participants prepare for the final presentation of their solar water heaters. Provide them with relevant hints or guidelines.

Trainer Notes

The final presentation of the solar water heater should be given by the participants as if they were presenting their solar device to their in-country counterparts or a group of villagers.

It should be thorough and not too technical.

The participants should be encouraged to be creative in their final presentations. Encourage them to use such non-formal education techniques as posters, puppets, diagrams, drawings and discussions.

The presentation does not have to be a straight lecture presentation, although this is always an option. Explain that they should try to think of ways to involve the people watching the presentation, to get their participation. Above all, stress the need for creativity, experimentation and various communication techniques.

MONITORING AND ASSESSING SOLAR-HEATED TEMPERATURE AND VOLUME

Each group should establish procedures to measure the amount and temperature of water. You will need a thermometer and a pre-measured container for the water and a pen and paper to record the data each time the water is used.

Be sure to include the time of day the water was taken, the amount, the temperature and any relevant comments.

Plot a graph that illustrates water quantity vs. temperature.

From the graph and the data collected, determine how much water was available above the temperature stated in the heater design specifications.

Please answer the following questions:

* Was the water heater properly sized for the volume and temperature required during the activities?

* Does the system provide the volume and temperature to meet the design specifications?

* If your yearly income was less than $5,000 per year, would you invest in this water heater? ($100 per year?)

MULTI-MEDIA STANDARD FIRST AID

Total time: 8 hours

Objectives:

* To discuss cross-cultural factors which influence the way in which first aid is applied
* To discuss first aid as an appropriate technology for health
* To develop first aid skills and knowledge

Resources:

* American Red Cross, Multi-Media Standard First Aid Instructor's Manual
* Werner, Where There Is No Doctor, pp. 75-106

Trainer Notes

* The Multi-Media Standard First Aid course offered by the American Red Cross provides a film, a student workbook, a first aid text and a final examination.
* This course can be obtained by contacting in advance any American Red Cross office. Outside of the United States, the central Red Cross office in the capital city should be contacted.

Materials: Film, projector and screen. Chalkboard or newsprint and felt-tip pens.

Trainer Notes

The Multi-Media course packet includes all necessary materials (bandages, splints, blankets, certificates, etc.) for conducting this course.

Procedures:

Trainer Notes

The Multi-Media course is recommended and covers all areas of emergency "first response." The course certifies participants in basic first aid for two years. It must be administered by a certified instructor. If any participants are already certified, they may serve as technical assistants. The course is designed in four units and can be given in one full day or spread out over several days.

Continued

Trainer Notes/Continued

there are more than 15 participants, it is recommended that
u obtain assistance from an additional certified instructor.

Step 1. (20 minutes)
Give a brief introductory talk and encourage a discussion about the role of the Volunteer in emergency situations.

Trainer Notes

ıclude the following points:

- A definition of first aid.
- An understanding that the role of the volunteer does NOT include being a "barefoot doctor"
- The issue of fear and panic as a response to emergencies
- The appropriate applications in crosscultural settings (sex roles, customs, legalities, etc.)
- The idea of first aid as an appropriate technology for health and self-reliance

Step 2. (7 hours, 30 minutes)
Conduct the four units of the course as described in the _Instructor's Manual_.

Step 3. (10 minutes)
Reconvene and evaluate the first aid course.

Trainer Notes

he following questions will stimulate discussion:

- Do you feel the course has prepared you to respond to emergency situations?
- Was the format effective?
- How could the session be improved?

ncourage participants to investigate in-country emergency olunteer facilities.

WIND TECHNOLOGY

Total time: 2 hours

Objectives:

* To describe the characteristics of a good wind site
* To identify several types of wind machines and their major uses
* To discuss advantages and disadvantages of locally-designed and built wind machines

Resources:

* Attachment IV-12-A, "Good and Bad Sites for Wind Machines"
* Attachment IV-12-B, "Dempster Typical Windmill Installation"
* Attachment IV-12-C, "Wincharger 12 Volt Wind Electric Battery Charger"
* Attachment IV-12-D, "Savonious Rotors and Other Wind Machines"
* Attachment IV-12-E, "Wind Power Formula"
* Barnhart and Hirschberg, The New Alchemy Sailwing
* Moore, Pradera Windmill
* VITA, "Horizontal Axis Sail Rotor Windmills"

Materials: Newsprint, felt-tip pens, notebooks, pens and pencils

Trainer Notes

There are direct uses of solar energy, such as solar water and space heating. But there are also indirect uses of solar energy, such as water and wind power. This session serves to introduce participants to one of these indirect uses of solar energy.

This session is included in response to what has been a continually expressed felt need on the part of previous program participants, i.e., to understand wind technology as an example of indirect solar energy.

Continued

Trainer Notes/Continued

This is intended as an optional session which can be used as a format for the discussion of other indirect applications of solar energy. (For example, hydraulic rams, micro-hydroelectric power, solar stills, solar cookers, biogas production, cookstoves, etc.) The choice of the session theme should be a response to participant's needs and/or in-country programming needs.

The "Discussion Questions" (See Step 2) should be modified to reflect the chosen theme. They should be written out on newsprint prior to beginning the session.

Step 1. (5 minutes)
Present the objectives and describe the session activities.

Step 2. (15 minutes)
Post, review and clarify the "Wind Technology Discussion Questions."

Trainer Notes

Post, on newsprint, the following questions, leaving space between each question for filling in responses (See Step 3):

Wind Technology Discussion Questions

1. What are some characteristics of a good wind site?

2. What are some types or styles of wind machines?

   a. Mass-produced

   b. Locally-made

3. What are some potential applications of wind machines?

4. What are some advantages and disadvantages of locally-designed and -built wind pumps versus imported U.S. multi-blade wind pumps (i.e., in Africa)?

5. How does $P = V^3 d^2$ relate wind machine power to wind velocity and blade diameter?

Remember to leave ample space between each question for filling in the responses.

Step 3. (20 minutes)
Have participants form groups of 3 to 5 people and develop responses to the "Discussion Questions."

Trainer Notes

* Ask that one member of each small group copy the questions and record the group's responses.

* You should circulate among the groups to see if they need any help.

Step 4. (40 minutes)
Reconvene the groups and encourage a discussion of their responses.

Trainer Notes

* As the responses are being discussed, you should note appropriate answers to the questions in the space under each question on the posted newsprint.

* Be sure that all participants understand the answers to each question.

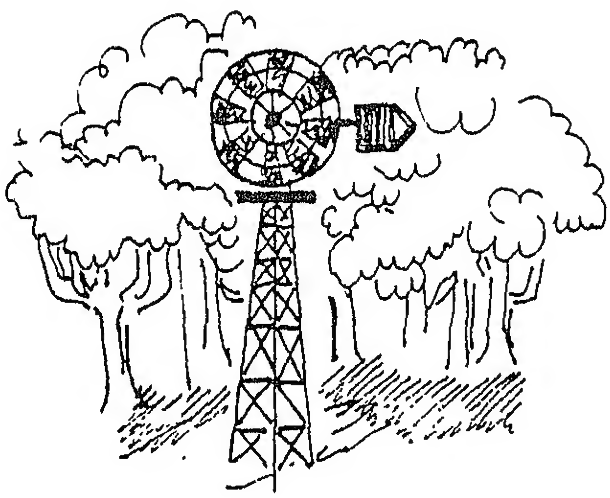
* Ask those participants who understand the concepts being discussed to assist those who are having more difficulty.

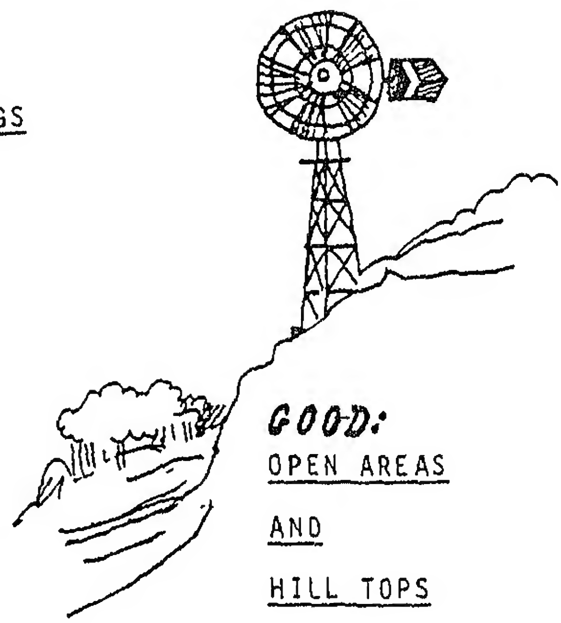
Step 5. (30 minutes)
Distribute and explain the attachments and other available wind technology resources (See "Resources").

Step 6. (10 minutes)
Conclude the session by reviewing the objectives and checking to see if they were met.

GOOD AND BAD SITES FOR WIND MACHINES

BAD: NEAR TREES OR BUILDINGS





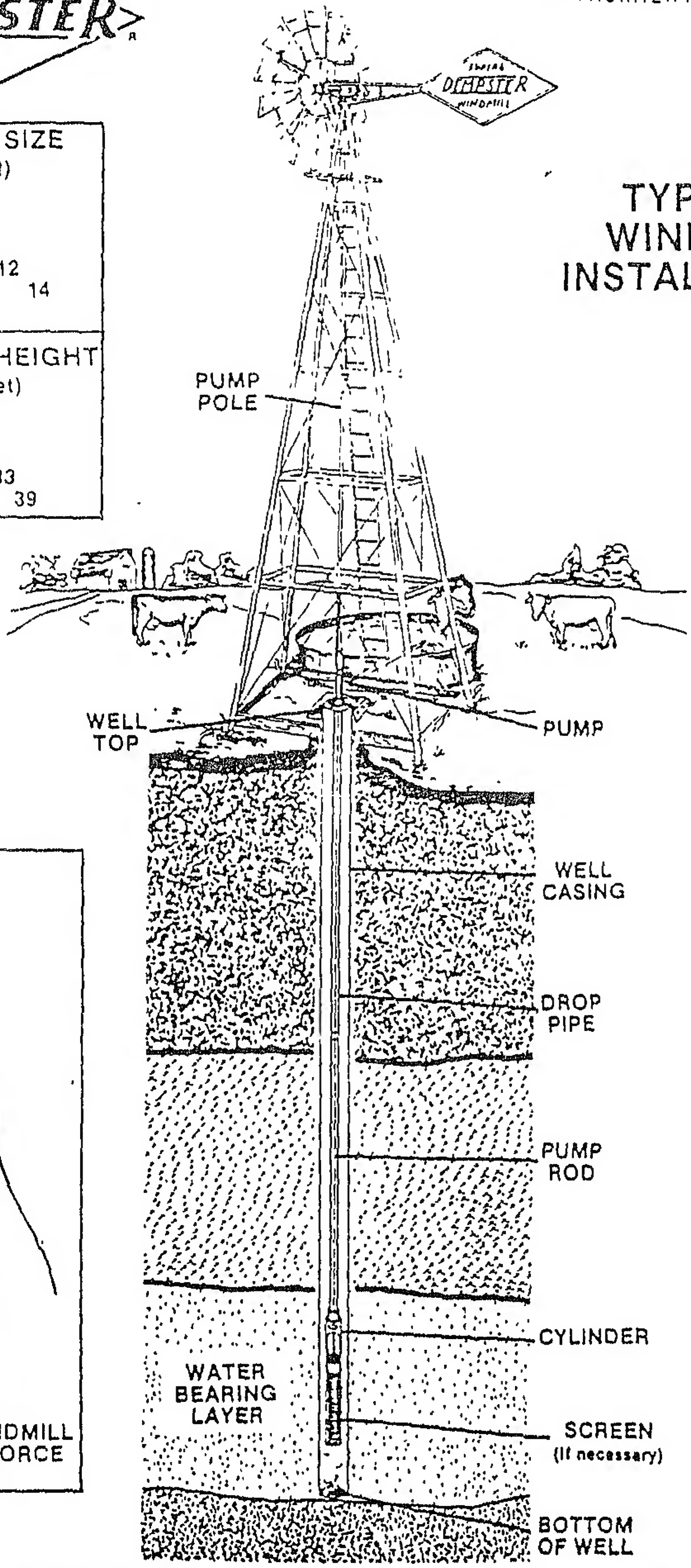
GOOD:
OPEN AREAS
AND
HILL TOPS

DEMPSTER

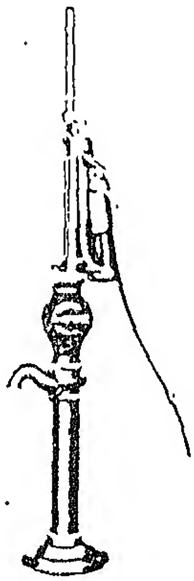
WHEEL SIZE (Feet)
6
8
10
12
14

TOWER HEIGHT (Feet)
22
28
33
39

TYPICAL WINDMILL INSTALLATION

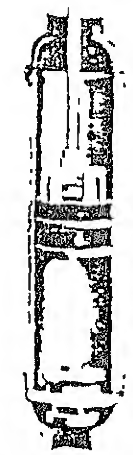


PUMP

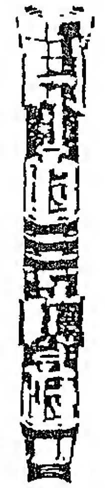


HAND & WINDMILL OPEN OR FORCE PUMP

WELL CYLINDER



CLOSED TOP
(Normal Use)
Shallow Well



OPEN TOP
(Deep Wells)
Remove the Plunger Assembly without pulling Pipe or Cylinder

GET

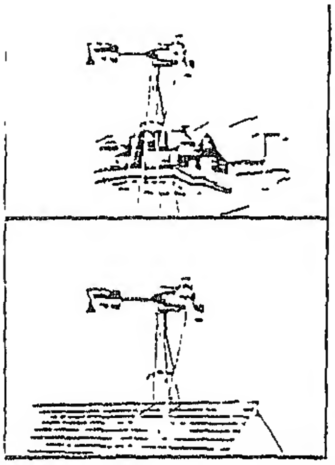
MAXIMUM POWER

FROM THE

FREE WIND

WITH A

HEAVY DUTY 12 VOLT



12 VOLT WIND ELECTRIC BATTERY CHARGER

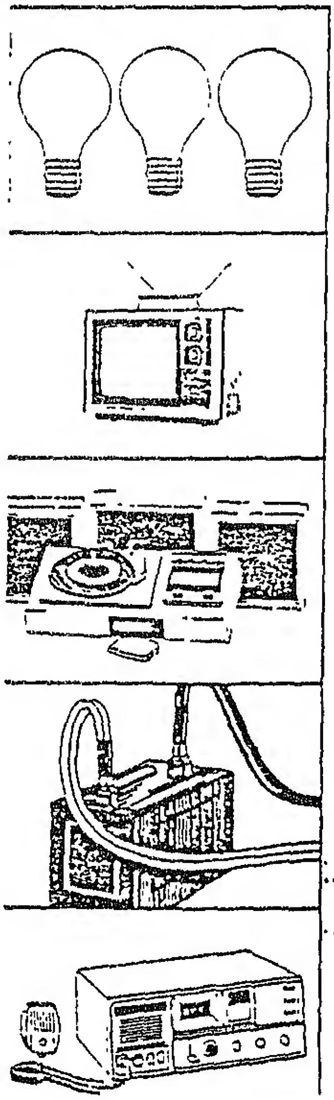
ATTACHMENT IV-12-C - Page 1

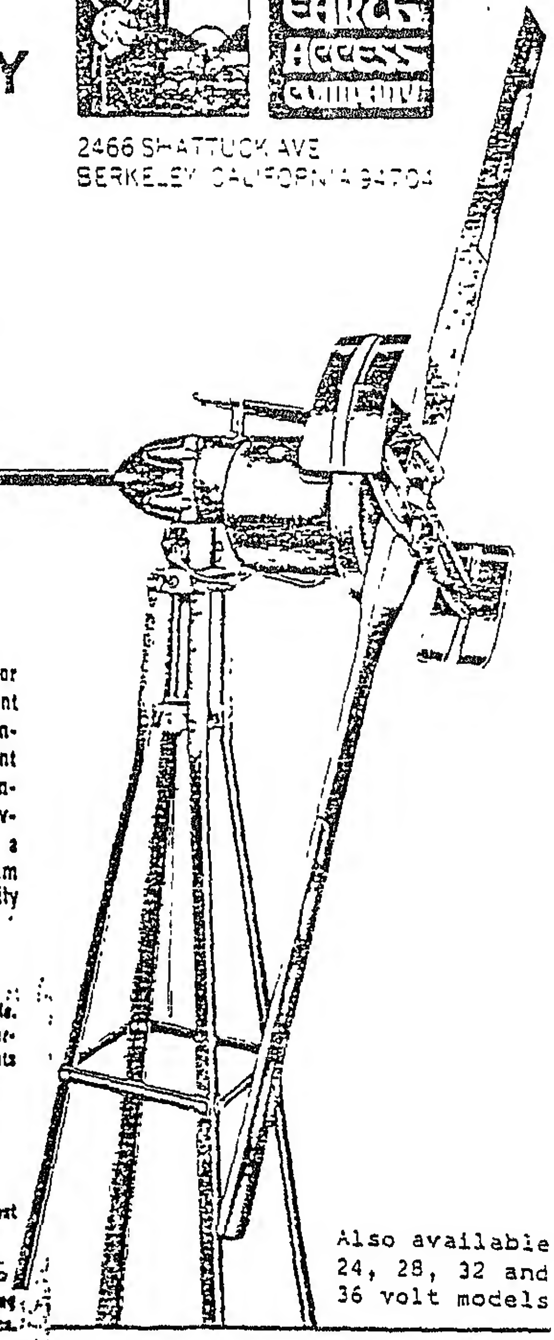
Whole Earth Access Company

2466 SHATTUCK AVE
BERKELEY CALIFORNIA 94704

MODEL NO. 1222H WIND ELECTRIC

BATTERY CHARGER





STARTS CHARGING IN
7 MILE AN HOUR BREEZE

The ideal source of electrical power for remote applications where a limited amount of 12V electricity is required. The Wincharger 12V Heavy Duty Wind Driven Plant requires a minimum amount of maintenance and gives years of trouble free service. The Wincharger starts charging in a 7 mile breeze and reaches its maximum charge of 14 amperes in a wind velocity of 23 miles per hour.

6 FOOT PROPELLER . . .
Built on the famous Albers Air-Foil principle. Machine made . . . perfectly balanced. Copper-armored leading edges. Protected by three coats of weather-proof varnish.

200 WATT GENERATOR . . .
Bearings grease sealed. 7½" frame diameter.

ENCLOSED COLLECTOR RING . . .
Provides complete protection against dust, frost and ice. Equipped with double carbon brushes.

NO RADIO INTERFFERENCE . . .
Condensers on generator and special grounding spring inside generator eliminate radio interference.

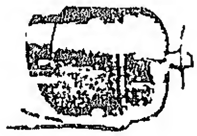
STRONG WINCHARGER TOWER . . .
Model 1222H mounts on sturdy 10 foot 4-leg angle iron tower. Rigidly braced . . . newest construction features. All parts fit perfectly to make erection simple

Also available
24, 28, 32 and
36 volt models

WINCO

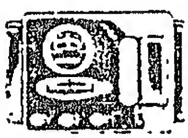
Division of DYNA TECHNOLOGY, INC.
SIOUX CITY, IOWA 51102

E. STURDY
RATOR



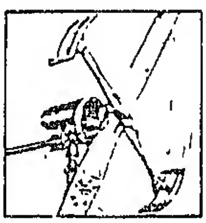
ger's heavy duty, 4 Pole 7½"
r generators are built for long
low maintenance Ball bear-
permanentally sealed

ATED INSTRUMENT



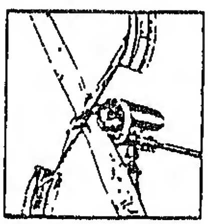
etely wired Connections-
for easy installation Reverse
device Ammeter shows
of charge or discharge Volt-
ulator not available

TED AIR-BRAKE
IOR



"Normal"

s by centrifugal force. When
ocity exceeds 23 miles per
overnor flaps automatically
nd spread wind away from
r (See illustration). Governor
s as a fly wheel to main-
n propeller speed and elim-
ration in gusty wind



"Governing"

can be mounted on pitched
a mounted platform, or on
surface of any height.

al Voltage Available at extra cost
olt, 28 volt, 32 volt and 36 volt

CHARGING RATES:

Revolutions Per Minute	Amperes
270	0
350	2½
440	6
570	10
700	12
900	14

MANUFACTURED BY

WINCO

Division of DYNA TECHNOLOGY, INC.
East Seventh at Division St.
P.O. Box 3263
Sioux City, Iowa 51102

WINCHARGER

STANDARD EQUIPMENT INCLUDES:

- INSULATED INSTRUMENT PANEL
- 6 FOOT PROPELLER
- 200 WATT GENERATOR
- ENCLOSED COLLECTOR RING
- AIR BRAKE GOVERNOR
- 10 FOOT WINCHARGER TOWER

SPECIFICATIONS

Tower	10 Feet High
Propeller Type	2 Blade
Size	6 Feet
Material	Wood
Gear Ratio	Direct
Generator	7½" Diameter 4 Pole

Capacity (Watts)	200
Approximate Maximum Amps.	14
Approximate Maximum Volts	15
Generator Speed Range (RPM)*	270/900
Governor Type	22" Air-Brake

WEIGHTS	Net	Domestic Shipping	Export Shipping	Vol. Cu. Ft
Generator and Parts	61 Lbs.	67 Lbs.	93 Lbs	1.7
Tower and Propeller	70 Lbs	74 Lbs	103 Lbs.	3.0
Governor Assembly	3 Lbs.	4 Lbs.	7 Lbs.	.4

Propeller Speed Range (RPM)*	270/900
Wind Speed Range (MPH)*	7/23
Voltage Regulator	Not Available

Average Usable KWH per month

10 MPH Average	20
12 MPH Average	26
14 MPH Average	30

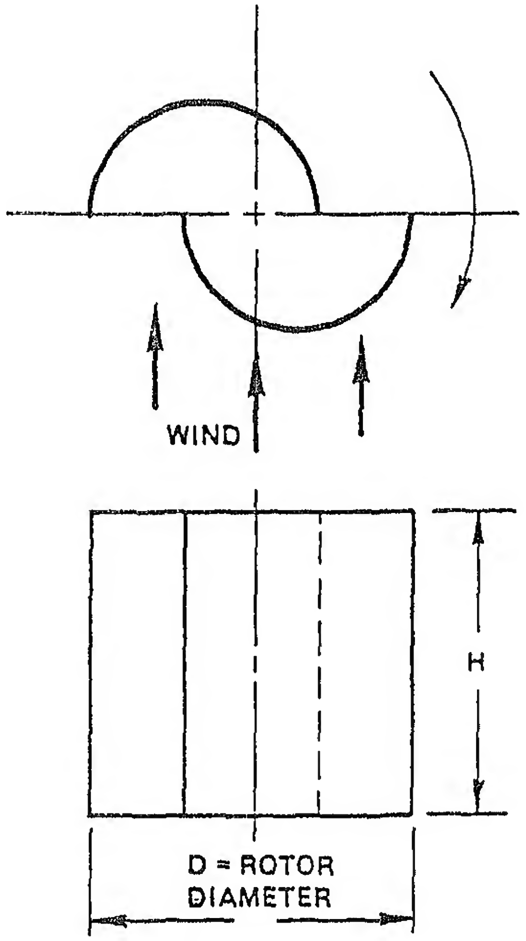
Size Battery Recommended (Battery not included)	230 A.H.
No. Battery Cells	6
Volts per Cell (When fully charged**)	2.5

* Wind and Propeller and Generator speed ranges as given indicate first the speed that is required to begin charging the battery and then the speed required for the governor to begin operation.

For example: On Model 1222 the propeller begins charging the battery at 260 RPM which corresponds to a generator speed of 260 RPM and a wind speed of 7 MPH. Governing speed is reached at 700 RPM, which corresponds to a generator speed of 700 RPM and a wind of 23 MPH.

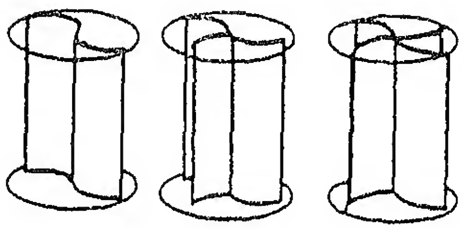
**For lead acid batteries only.

SAVINIOUS ROTORS AND OTHER WIND MACHINES

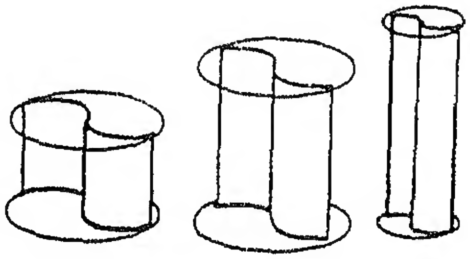


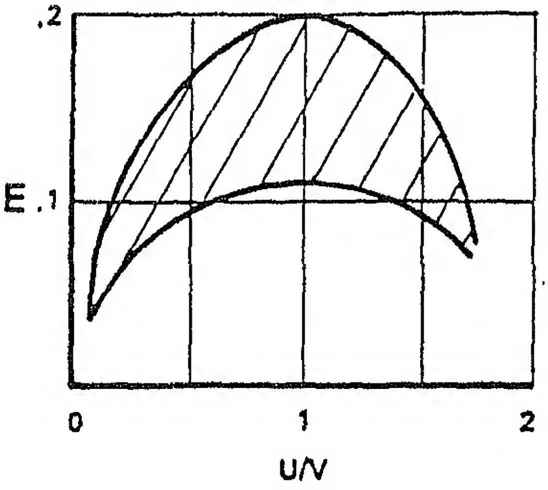
SINGLE TIER
SAVONIOUS

NUMBER OF VANES

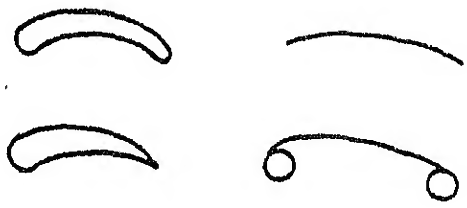


ASPECT RATIO



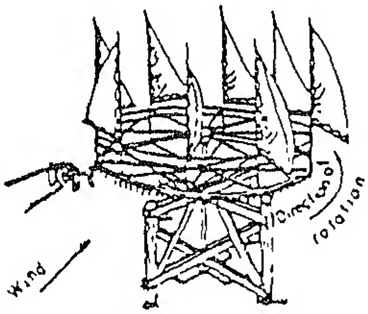


VANE FORM

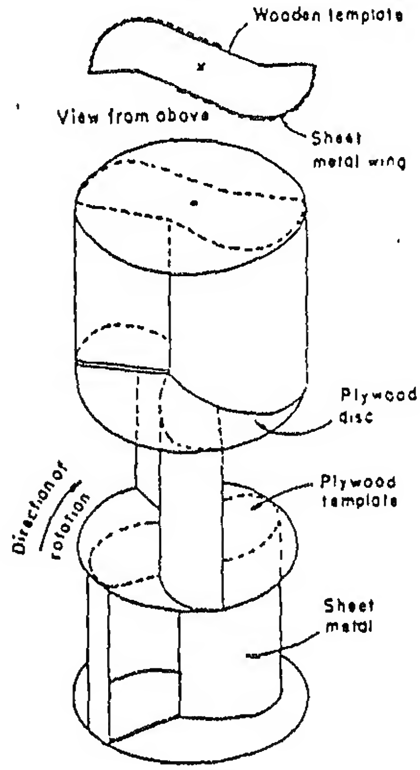


CONFIGURATIONS

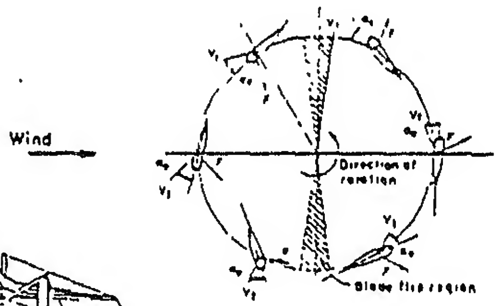
SAVONIOUS ROTORS AND OTHER WIND MACHINES/CONTINUED



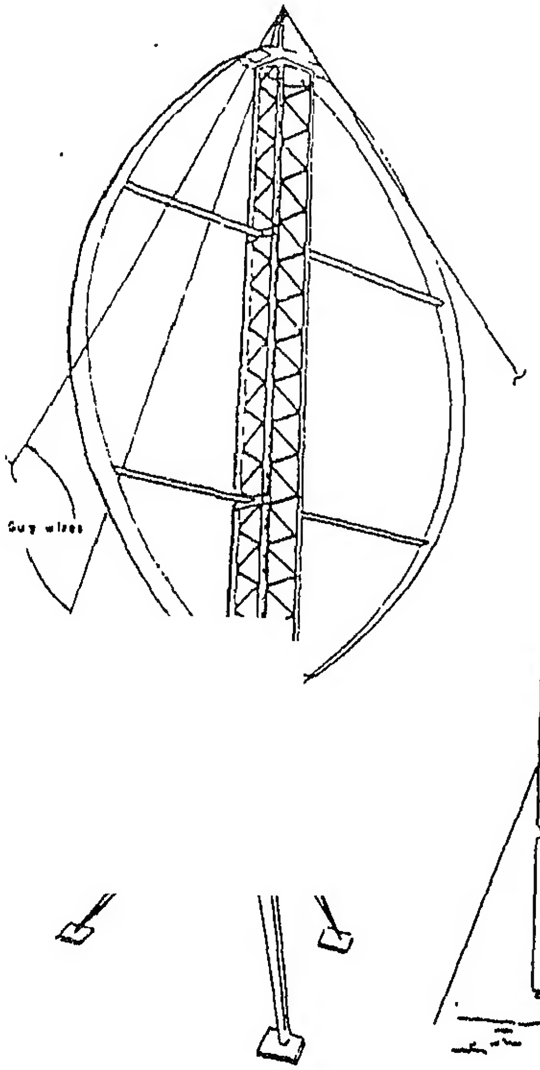
Thai jib-sail rotor



Three-tiered Savonius rotor



Gyrorotor blade modulation



Darrieus rotor

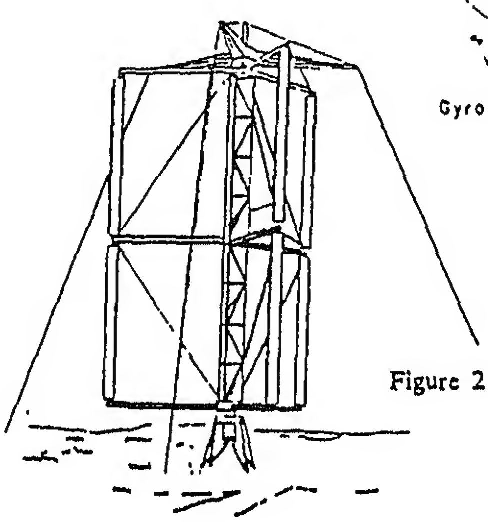


Figure 21. Gyro rotor

WIND MACHINE POWER FORMULA AND SITING

$P = V^3 d^2$

Where: P = Power available from the wind generator

V = Velocity or speed of the wind

d = Diameter of the propeller

VOLUNTEER IN DEVELOPMENT
PART 2: WOMEN IN DEVELOPMENT

Total time: 2 hours

Objectives:
* To discuss Women in Development issues
* To discuss the role of the Peace Corps Volunteer in relation to Women in Development issues

Resource: Huston, Third World Women Speak Out

Materials: Newsprint and felt-tip pens

Trainer Notes

There are two optional activities outlined in this session, each designed to independently meet the session objectives. Both need preparation.

Option #1: Requires the formation of a discussion panel of Third World women

Option #2: Depends on the preparation of discussion leaders selected from among the participants and requires providing them with copies of the resource book, Third World Women Speak Out

Option #1, panel of Third World women

Trainer Notes

* The discussion panel should consist of from 3 to 5 Third World women.

* There are several ways to go about forming the discussion panel. If the training program is outside the United States, it may pose no problem because you can call on staff and/or friends. Programs within the United States may require your contacting a nearby university. Most universities have a foreign student office and are generally accustomed to responding to requests for foreign student speakers.

* After you have identified the panel members, meet with them ahead of time, briefing them on the session objectives and procedures. Also explain to them that they will be asked to speak on the topics related to Third World women identified in Part 1 of Women in Development (See Phase III: Session 19). It is important that the panel members understand they will be asked to speak informally for up to ten minutes at the beginning of the session. Be certain to allow sufficient time for them to prepare.

ocedures: Step 1. (10 minutes)
State the session objectives. Introduce the panel members and outline the procedure for the panel discussion.

Trainer Notes

Mention the topics related to women in development that were identified by the participants during Phase III: Session 19.

Step 2. (30 - 50 minutes)
Have each of the panel members give a brief talk (up to 10 minutes) on individual perceptions of the roles of women in development.

Step 3. (55 - 1 hour, 15 minutes)
Open the panel to questions and discussion.

Step 4. (5 minutes)
Close the panel by briefly summarizing any conclusions and thanking the panel members for their participation.

Option #2, Women in development discussion panel

Trainer Notes

o prepare for this activity you will need five volunteers from mong the participants to act as discussion leaders/facilita-ors. Remind the volunteers of the topics identified in the revious women in development session (Phase III: Session 19). xplain that each of them should select a chapter from Huston's hird World Women Speak Out and prepare a brief (up to 10 inute) report on the chapter, highlighting any situations that efer to any of the women in development topics. Also, explain hat during the session they will be asked to facilitate a 10-inute discussion on their reports. Mention that they should ocus the discussion on what role might be played as Peace orps Volunteers in trying to improve the situation of women. nform them that time will be set aside at the end of the ession for feedback on their facilitation skills.

cedures: Step 1. (5 minutes)
Review the session objectives, outline the session activities and introduce the discussion leaders/facilitators.

Step 2. (1 hour, 40 minutes)
Have the first discussion leader/facilitator present the 10-minute report and facilitate a 10-minute discussion on the report, including comments on the role that might be played as

Peace Corps Volunteers in trying to improve the situation of women in the Third World.

Trainer Notes

Repeat the process for each discussion leader/facilitator.

Step 3. (5 minutes)
Discuss and summarize some of the key points which were brought out by the reports.

Step 4. (10 minutes)
Conclude by encouraging feedback on the facilitation skills of the discussion leaders/facilitators.

Trainer Notes

Elicit feedback by asking the following questions:

* What did you like best about (name of facilitator)'s report and facilitation of discussion?

* What could have been done to make the report better?

HOUSE DESIGN IN FOUR CLIMATES

Total time: 2 hours

Objectives:
* To compare and contrast indigenous house design in the four basic climatic zones of the world
* To design a house for one of the four climates

Resources:
* Rudofsky, Architecture without Architects
* Wright, Natural Solar Architecture
* Wright, Writings and Buildings
* Olgyay, Design with Climate

Materials: Newsprint, felt-tip pens, notebooks, pens or pencils

Procedures:

Step 1. (5 minutes)
Present the objectives and describe the session activities.

Step 2. (20 minutes)
List the four basic climates of the world and brainstorm a list of characteristics of indigenous house or building design for each of the climates.

Trainer Notes

The four climates are:

* Hot Humid (i.e., Miami, Florida; Monrovia, Liberia)
* Hot Arid (i.e., Phoenix, Arizona; Ouagadugu, Upper Volta)
* Temperate (i.e., New York, New York; Santiago, Chile)
* Cool (i.e., Grand Rapids, Michigan LaPaz, Bolivia)

Ask if any of the participants have lived in the cities listed by each climate.

Have participants name characteristics of indigenous architecture for each one of the climates. Variables would include: type of construction, materials, insulation, ventilation, solar heating, shading, natural cooling, vegetation, etc.

Step 3. (30 minutes)
Ask the participants to form four small groups and have each group design a house (floor plan and elevation or perspective drawings) for one of the four climates listed on the newsprint.

Trainer Notes

Circulate among the groups and help with design, drawing, discussion, etc.

Step 4. (45 minutes)
Reconvene the groups and have a representative from each one present their house design.

Trainer Notes

Briefly discuss each design at the end of each presentation.

Step 5. (20 minutes)
Conclude the session by comparing and contrasting the different designs.

Trainer Notes

* Discuss the difficulty of designing a house in only 30 minutes.

* Refer the participants to the texts listed under "Resources."

* Ask the group, "If you have the opportunity to build your own house in-country, how would it differ (if at all) from existing local homes in the U. S.?

PRESENTATION OF SOLAR WATER HEATERS

Total time: 4 hours

Objectives:
* To give a presentation explaining the design, construction and applicability of a solar water heater
* To demonstrate effective facilitation skills and non-formal education techniques
* To evaluate the solar water heater phase

Resources: Pett, Audiovisual Communication Handbook

Materials: As needed by each presentation group

Trainer Notes

Four hours of preparation time was allotted for these presentations in Phase IV: Session 10.

Procedures: Step 1. (5 minutes)
Review the session objectives and procedures.

Step 2. (20 minutes)
Explain the basic format for each presentation and give participants a few minutes to decide among themselves how they will give the presentations.

Trainer Notes

You should point out that prior to beginning the presentations, it will be necessary to establish an order in which the presentations will occur, set time limits, allot time at the end of each presentation for questions and feedback and name a timekeeper.

Explain that the basic format for each presentation should be:

* To set up any necessary materials, devices, visual aids, etc.
* To explain to the audience the role that they should be assuming, e.g., villagers, university professors, host country agency representatives, Peace Corps trainees, etc.
* To give the presentation
* To ask for questions or further clarification
* To ask for feedback regarding NFE techniques and facilitation skills.

Step 3. (3 hours, 10 minutes)
Have each group give their presentation.

Trainer Notes

The feedback activity at the end of each presentation is important because it will help participants improve their skills at facilitating presentations. You should provide some focus for this portion of each presentation by asking the following questions:

* What did you think was the most effective part of the presentation? The least?
* What NFE techniques were used?
* Was the audience invited to participate?
* Do you think the presentation was clear?
* Could it be used in a village setting in the Third World?
* What are some examples of effective facilitation skills that were demonstrated?
* What could have been done to make the presentation better?

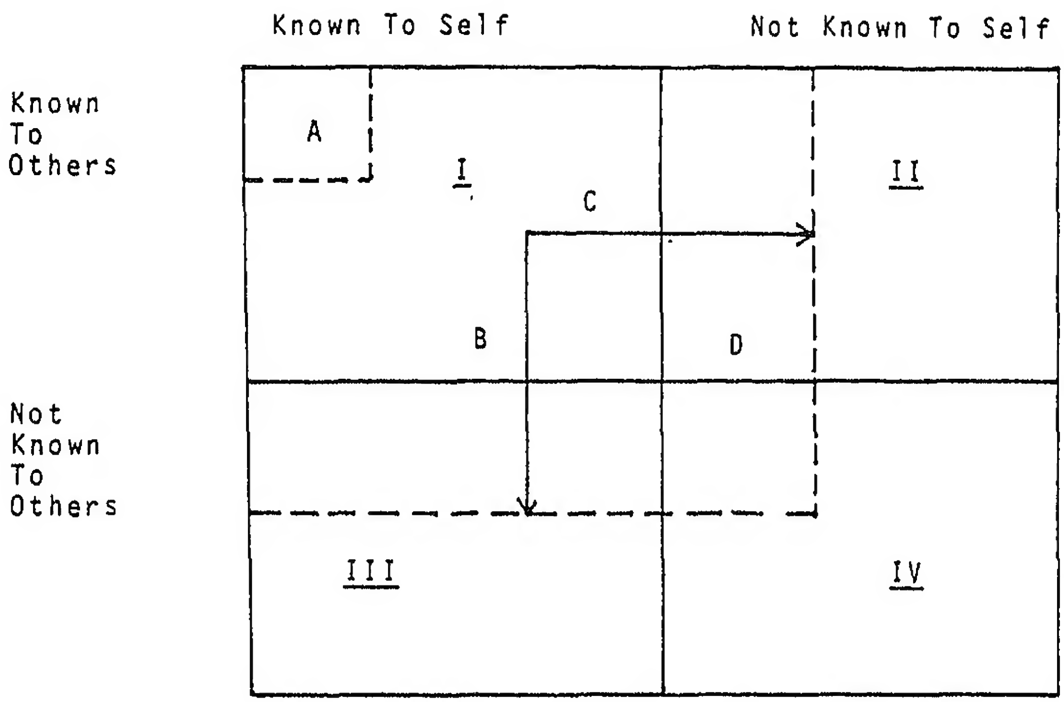
Step 4. (25 minutes)
Have the participants regroup and give feedback regarding the overall solar water heater phase.

Trainer Notes

You should center this discussion around some of the following questions:

* Were all or most of the phase's objectives met?
* What was the most important thing each participant learned during the phase?
* What did you like the least about the phase?
* How did the group dynamics work during the phase?
* How were problems solved during the design and construction sessions?
* Did the problem-solving change during the phase?
* What do people think of solar water heating as an appropriate technology?

JOHARI WINDOW



Description of Areas:

Area I: Information about self known to self and known to others. The area of free activity and interaction. "Public or Shared Self"

Area II: Information about self not known to self and known to others. The Blind Area -- sometimes called the "Bad Breath Area."

Area III: Information about self known to self and not known to others. Avoided or Hidden Area. The "Private or Secret Self."

Area IV: Information about self not known to self and not known to others. The area of Unknown Activity. The "Area of Hidden Potential."

JOHARI WINDOW/Continued

Most people enter a new environment with a very small Area I (A). There is very little shared information and very little interaction can take place.

As the person becomes more comfortable, he shares some information about him/herself and expands toward Area III (B).

If the person is open for feedback to occur, he expands toward Area II (C).

The result of these two activities is that totally new information and potential in Area IV (D) is discovered. These new learnings from Area IV are directly attributable to interaction in the new environment.

* * *

NOTE:

There is no pressure to "reveal" yourself. There is nothing inherently "good" about having a large Area I. However, having an expanding or expandable Area I does increase your area of interaction and tends to facilitate the entering of a new environment.

CONSTRUCTION OF EARTHEN BLOCK MOLDS: A FOCUS ON GROUP DYNAMICS

Total time: 4 hours

Objectives:

* To construct earthen block molds
* To examine and discuss the characteristic decision-making styles within work groups
* To list some generalizations about effective group decision making

Resources:

* Attachment I-12-A: "Earthen Block Molds"
* Attachment I-12-B: "Effective Group Survey"
* Attachment I-12-C: "The Decision-Making Process"

Materials: Scrap lumber (5cm x 10cm or 2.5cm x 10cm/ 2" x 4" or 1" x 4"), nails, hammers, saws, metric tape measures, newsprint and felt-tip pens

Procedures:

Step 1. (5 minutes)
Present the session objectives and outline the activities.

Trainer Notes

> Explain that today's session is the first step towards the next day's activity of actually making earthen blocks.

Step 2. (5 minutes)
Distribute Attachment I-12-A: "Earthen Block Molds." Referring to the attachment, give instructions on how to construct the molds and present the tools and materials.

Trainer Notes

> While giving the instructions, explain the following:
>
> * The difference between individual and gang molds.
> * The size of the mold depends upon the desired block size and its intended use.
> * The mold dimensions listed on the attachment are interior dimensions.

Continued

Trainer Notes/Continued

* The participants should practice building the molds using metric measurements.

* Molds should be rigid and easy to handle.

Step 2. (5 minutes)
Ask the participants to form construction groups consisting of three individuals and explain that:

* Each group should utilize one of the three possible dimensions given for individual mold construction.

* An attempt should be made to work cooperatively with the active participation of all group members.

Step 3. (1 hour)
Have the groups build the individual molds.

Trainer Notes

It is important to circulate among the construction groups while they are working to check the progress and to see if the mold is rigid and built to specifications.

Step 4. (15 minutes)
Ask each group to join with another and discuss members' observations of the group process, both on a technical and interpersonal level.

Trainer Notes

Explain that the groups should select one of their members to act as a facilitator for the discussion.

The following questions may serve as guidelines for the group discussions:

* How did group members react regarding various individual technical skill levels in the group?

ance to work with people of a

during the construction process?

) or impeded mutually-shared

: to help the group function

Step 5. (15 minutes)
Have participants take a break.

Step 6. (1 hour)
Ask the participants to form groups of six and build a gang mold.

Step 7. (10 minutes)
Instruct each group to discuss the differences between working in small and large groups.

Step 8. (10 minutes)
Distribute Attachment I-12-B, "Effective Group Survey." Ask the participants to complete it and discuss their responses within the group.

Step 9. (10 minutes)
Distribute Attachment I-12-C, "The Decision-Making Process," and allow time for the participants to read it.

Step 10. (15 minutes)
Ask each group to select a member to facilitate a discussion of the potentially positive (satisfying) or negative (frustrating) consequences of each decision-making technique.

Also encourage the groups to recall examples of the decision-making styles used within their groups during the construction of the molds.

Trainer Notes

It is helpful to point out that all the styles, with the exception of consensus, often preclude the full involvement and commitment of some group members or ignore important issues that should be raised.

Mutually shared decision-making (termed consensus) is a positive alternative to other styles. Although it may require more time and increased sensitivity to the individual group members, it provides for the involvement and commitment necessary to group cohesiveness and cooperation.

Step 11. (20 minutes)

* Reconvene the groups and ask group members to share their views on the decision-making styles used by their group and the extent of cooperation within the group.

* Record their responses on newsprint.

* When several generalizations have been recorded, the session should end by reminding the participants that what remains to be done is for them to apply these generalizations.

Trainer Notes

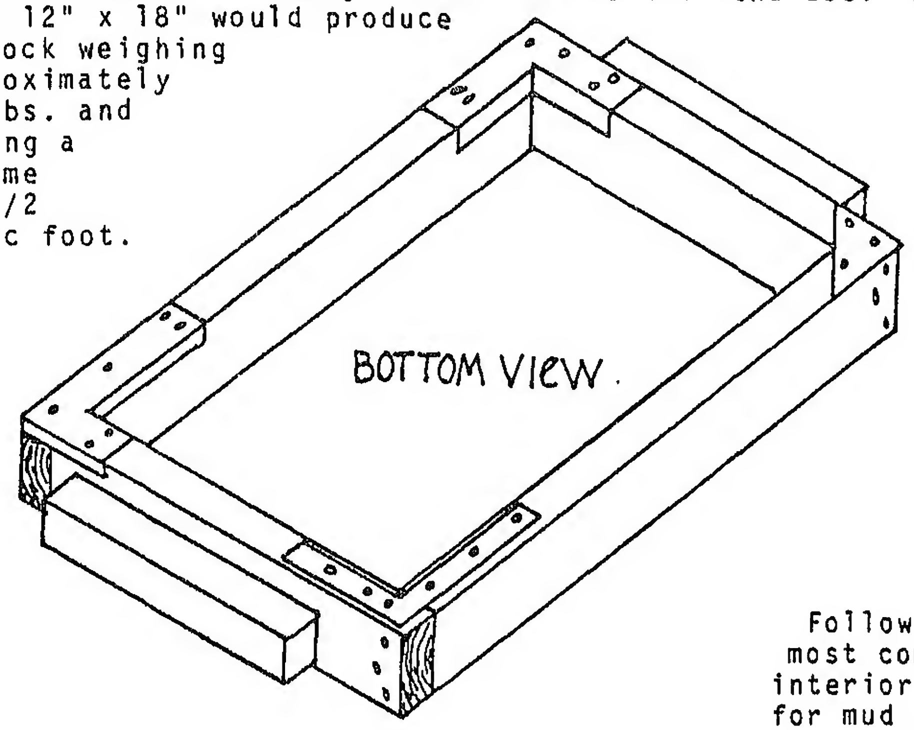
The intent of this wrap-up discussion is to have the participants develop some useful generalizations they will be able to apply in future work groups.

For example, there should be some agreement about what kind of behavior improved group performance. Or there may be certain things everyone agrees ought not to be done again.

Both of these are good examples of useful generalizations from what the participants have experienced, published (shared) and processed.

EARTHEN BLOCK MOLDS

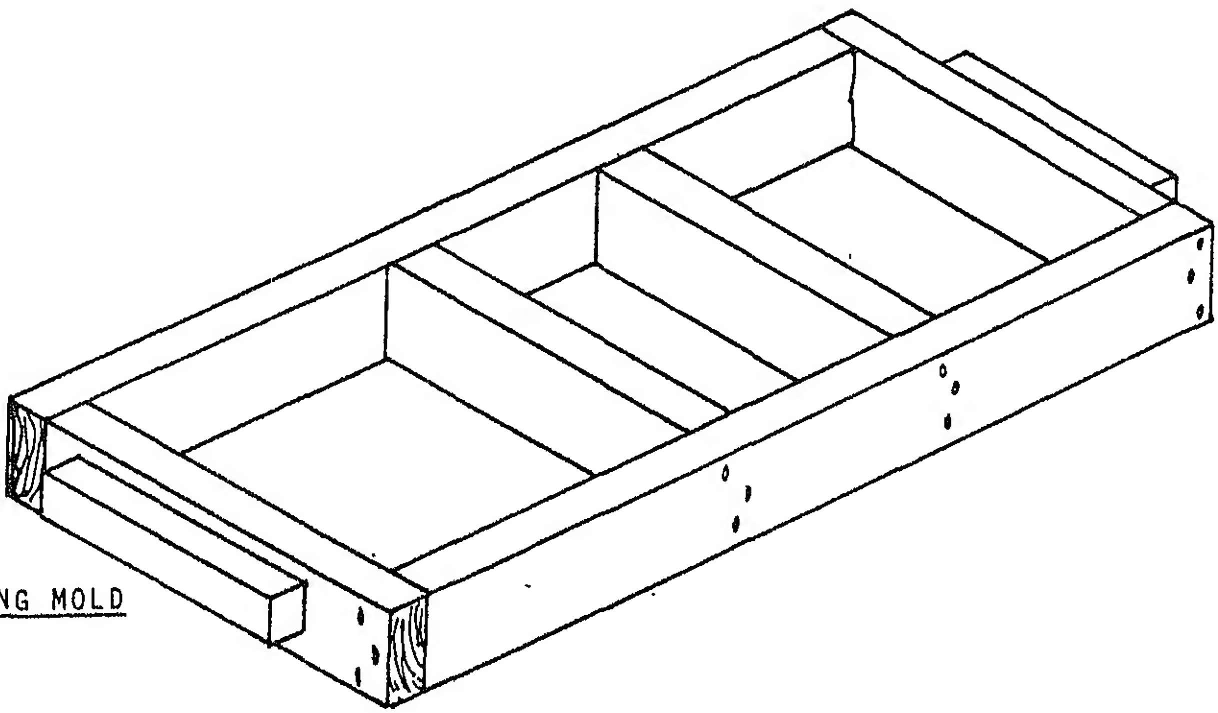
There are both individual and gang molds and are usually constructed from 2" x 4" (5 x 10cm) or 1" x 4" (2.5 x 10cm) lumber. Size of the blocks vary in accordance with end use. A mold of 4" x 12" x 18" would produce a block weighing approximately 50 lbs. and having a volume of 1/2 cubic foot.



INDIVIDUAL MOLD

Following are the most commonly used interior dimensions for mud block molds.

Inches	Centimeters
4 x 12 x 18	10 x 30½ x 46
4 x 7½ x 16	10 x 19 x 40½
4 x 10 x 15	10 x 25½ x 38



GANG MOLD

EFFECTIVE GROUP SURVEY

Group leaders, group facilitators and group members may sometimes want to assess the group's capability for working productively. This survey can be used by one or many, with the results posted and discussed toward the end of a meeting.

Directions: Circle the letter opposite each item on the survey below that best describes the group's interactions.

The scale used is:

A - All group members
B - Most group members (two-thirds or more)
C - About half the group members
D - A few group members (one third or less)
E - None of this group

During this (or the most recent) session, how many group members, including yourself:

1.	Gave due consideration to all seriously intended contributions of other group members?	A	B	C	D	E
2.	Checked (by paraphrasing, etc.) to make sure they knew what was really meant before agreeing or disagreeing?	A	B	C	D	E
3.	Spoke only for themselves and let others speak for themselves?	A	B	C	D	E
4.	Viewed all contributions as belonging to the group, to be used or not as the group decided?	A	B	C	D	E
5.	Had the opportunity to participate in the group if they desired to do so?	A	B	C	D	E
6.	Tried to find the reason if the group was having trouble getting work done?	A	B	C	D	E
7.	Helped the group make decisions openly rather than by default?	A	B	C	D	E
8.	Helped bring conflict into the open so the group could deal with it?	A	B	C	D	E
9.	Looked upon behavior which hindered group process as a group problem, rather than as a "problem member"?	A	B	C	D	E

Reprinted from Systematic & Objective Analysis of Instruction Training Manual. Portland,OR: Northwest Regional Educational Laboratory, 1970.

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Reprinted from Systematic & Objec
Manual. Portland,OR: Northwest Re

DECISION-MAKING PROCESS

all live and work in groups and undoubtedly have experienced ficulty in arriving at group decisions. Some groups tend to ak down when confronted with a decision for which a consensus required. Others get bogged down in the interminable discus- n of minor points or irrelevant side issues. Still others k escape from their anxiety in Robert's Rules of Order, voting calling upon the "chairman" to establish control.

Kenneth Benne (1960) has analyzed the prevalent reasons for difficulty groups have in making decisions and has identified following six blocks to decision making in groups.

1. <u>Conflicting Perception of the Situation</u>

   If group members view the problem at hand in different ways, communication can be impeded, resulting in a breakdown of the group.

2. <u>Fear of Consequences</u>

   The possible outcomes of an impending decision can overwhelm a group. Outside pressures on individuals or on the entire group may exert a paralyzing effect on its ability to come to a decision.

3. <u>Conflicting Loyalties</u>

   Every group member belongs to a number of different groupings than the one he may presently be engaged in. These multiple memberships can operate as hidden agendas or conflicting pressures within the decision-making group.

4. <u>Interpersonal Conflict</u>

   Personal differences or personality clashes can provoke defensiveness, antipathy and biased discussion, preventing a sound, fair decision from being made.

5. <u>Methodological Rigidity</u>

   Many groups are so frozen into Robert's Rules of Order or similar rigid methods for decision making that they are prevented from inventing or using other methods when the nature of the decision calls for one (e.g., consensus).

6. <u>Inadequate Leadership</u>

   When the entire group does not <u>share</u> the leadership functions and relies too heavily on a designated leader

THE DECISION-MAKING PROCESS - continued

(who may or may not be sufficiently skilled), then no group decision can be made and the commitment and responsibility to any decision is lessened.

TYPES OF DECISIONS

The following types of decision making are familiar to all of us:

1. Plops

   A decision suggested by an individual to which there is no response (e.g., "I suggest we shelve this question.")

2. Self-Authorization

   A decision made by an individual who assumes authority (e.g., "I think we should all write our ideas on the blackboard." --and proceeds to be the first to do so).

3. The Handclasp

   A decision made by two or more members of the group who join forces or decide the issue in advance (e.g., "That was a helpful comment, John. Yes, that's the course we're going to take.")

4. Baiting

   A decision made by pressure not to disagree (e.g., "No one objects, do they?), or a decision made by pressure to agree (e.g., "We all agree, don't we?).

5. Majority Rule

   A decision made by some form of voting.

6. Unanimity

   A decision made by overt and unanimous consent, often without discussion.

7. Polling

   A decision made by a form of voting which inquires, "Let's see where everyone stands." -- and then proceeds to tabulate the already expressed majority decision.

8. Consensus

   A decision made after allowing all aspects of the issue, both positive and negative, to be put forth to the degree that everyone openly agrees it is probably the best decision. This is not necessarily unanimity, but it constitutes a basic agreement by all group members.

CONSTRUCTION OF EARTHEN BLOCKS

Total time: 2 hours

Objectives:

* To compare various clay-sand mixes suitable for the construction of earthen blocks
* To construct earthen blocks

Resources:

* Adobe News Inc., "Adobe Today Newsletters"
* Boutette and Evans, Lorena Stoves
* Long, J. D., Adobe Construction
* Neubauer, L. W., Adobe Construction Methods, Manual 19

Materials:

* For the shake/feel/shine and ribbon tests: glass jar or bottle, water and soil samples
* For block construction: hoe, shovel, machete, appropriate earthen mixtures, water, straw and molds

Procedures:

Step 1. (10 minutes)
Introduce the session objectives and outline the procedures.

Step 2. (10 minutes)
Encourage the participants to share any experience or knowledge they may already have of earthen technologies.

Trainer Notes

During the discussion of the various types of earthen construction, mention the following applications:

* Wattle and daub
* Cob method
* Earthen blocks
* Compressed blocks
* Rammed earth
* Ferromud
* Bamboomud

Step 3. (10 minutes)
Describe the type of earthen blocks that will be made in today's session.

Trainer Notes

During your introduction, mention the following information:

* The utilization of mud blocks is often an appropriate substitute when access to manufactured construction material is limited and costs are high.

* Earthen blocks have many advantages: they are low-cost, durable and strong enough to be used as structural materials in a wide range of applications.

* Adobe buildings are fire-resistant, sanitary, dry and (due to the thermal properties of adobe) help equalize both hot and cold temperature extremes. Consequently, they are well-suited for use with passive solar heating designs.

* In addition, earthen construction is often an indigenous technology with which people may already be familiar.

* Earthen blocks are rectangular, shaped in molds, dried in the sun and then used in construction with mud or cement mortar.

* Bricks are made by mixing clay soil (28 - 48% clay) and water and then pouring the mixture into wood frame molds.

* Molds are generally 10cm x 30cm x 45cm (4" x 12" x 18"), having a volume of 16 liters (1/2 cubic foot) and weighing 23 kilograms (50 pounds).

* Blocks are left to dry three weeks, then turned on edge and left up to two weeks to cure.

Step 4. (15 minutes)
Have participants practice the shake/feel/shine/thread and ribbon tests. Encourage a discussion of their findings and observations.

Trainer Notes

You can provide a focus for this discussion by asking:

How can this knowledge about soil composition be applied when making earthen blocks?

The participants should understand that these tests are to determine the relative amounts of sand and clay in the soil and to become familiar with the different soil types. A reference to these tests can be found in Lorena Stoves, pp.42-44.

Continued

Trainer Notes/Continued

Mention the following information during the discussion:

* Clay is the glue that binds the sand particles together.

* Because sand is rigid and doesn't shrink during drying like clay, a mixture of clay and sand is less likely to crack.

* It is not only the amount of clay in the mixture but the type that affects cracking. Some clay types (Kaolin, for example) have a much lower expanding and shrinking quality.

Step 5. (10 minutes)
Have the participants assemble the construction materials.

Step 6. (5 minutes)
Ask the participants to form construction groups.

Step 7. (45 minutes)
Instruct the group to begin working and make earthen blocks using the following procedure:

* Sift the soil and sand through a 3mm to 5mm (1/8" to 3/16") mesh screen.

* Dig a shallow pit to use as a mixing basin.

* Mix soil, sand and water to stiff mud consistency by puddling.

Trainer Notes

Explain here that the blocks should be of varying proportions of soil/sand and some should contain different admixtures such as chopped straw. These different proportions will produce varying results that can be evaluated by the particpants as the blocks dry.

* Place a small amount of sand on the ground so blocks won't stick.

* Place the mold over the sand, making sure to wash the inside of the mold after each use.

* Fill the mold, ramming the mixture into all of the corners of the form, leveling the top and noting the soil/sand proportions on the surface of the block.

* Quickly withdraw the mold.

* Repeat the process until at least five blocks have been formed.

Trainer Notes

Circulate throughout the construction groups and offer assistance as needed.

Step 8. (5 minutes)
Reconvene the group and explain that the blocks should be turned on edge to allow for uniform drying in 2 or 3 days.

Trainer Notes

Encourage the groups to return periodically to examine the way in which the blocks are drying. Explain that ideally the blocks will dry completely in about two weeks.

Step 9. (10 minutes)
Have the participants clean up the work area and the tools.

GLOBAL ENERGY ISSUES

Total time: 2 hours

Objectives:
* To examine and discuss the differences in the world's per capita energy consumption
* To identify global energy issues and discuss ways of addressing them
* To compare energy consumption patterns in the U. S. with those of the Third World
* To discuss how this training program addresses some global energy issues

Resources:
* Eckholm, The Other Energy Crisis
* Crabbe and McBride, The World Energy Book
* Katz, Food: Where Nutrition, Politics and Cultures Meet
* Eckholm, Losing Ground
* Attachment I-14-A, "Per Capita Energy Use and GNP"

Materials: Newsprint and felt-tip pens

Trainer Notes

* In order to carry out this session well, it is important that you have a strong awareness of international development issues.
* Spend some time prior to the session reviewing the resource materials. If the participants have had limited international experience, ask them to complete the "Global Energy Questionnaire" in Katz, pp. 151-155 and 187-189 as an additional first step to this session.
* Write the objectives on newsprint before the session.

Step 1. (5 minutes)
Present the objectives and outline the session activities.

Step 2. (15 minutes)
Distribute, review and discuss Attachment I-14-A, "Per Capita Energy Use and GNP."

Trainer Notes

* Encourage participants to comment on the position of the United States on the chart and the position of the countries of the developing world.

* Ask them to identify some of the forms of energy used in the U. S. and in the developing world.

* Have them briefly discuss their consumption of energy here in the U. S. and how they expect it to change when in-country.

Step 3. (15 minutes)
Have the participants brainstorm a list of global energy issues. Encourage questions, comments and discussion.

Trainer Notes

* The list should include: deforestation, erosion, the population explosion, inequitable distribution of resources, political instability, displacement of people, pollution and environmental degradation, squandering of resources, poor balance of payments, etc.

* Write each issue on newsprint as it is stated.

* Ask people to give examples of each issue and try to trace the interrelationship between them.

Step 4. (40 minutes)
Have the participants form small groups and discuss in detail the global energy issues identified in Step 3.

Trainer Notes

Explain that each group should:

* List possible ways of addressing global energy issues.

* Identify ways in which this training program can begin to address them.

* Name a group member to serve as a recorder and write the key points of the discussion on newsprint.

* Identify responses to the issues which may not be covered during this program but could be addressed later in-country.

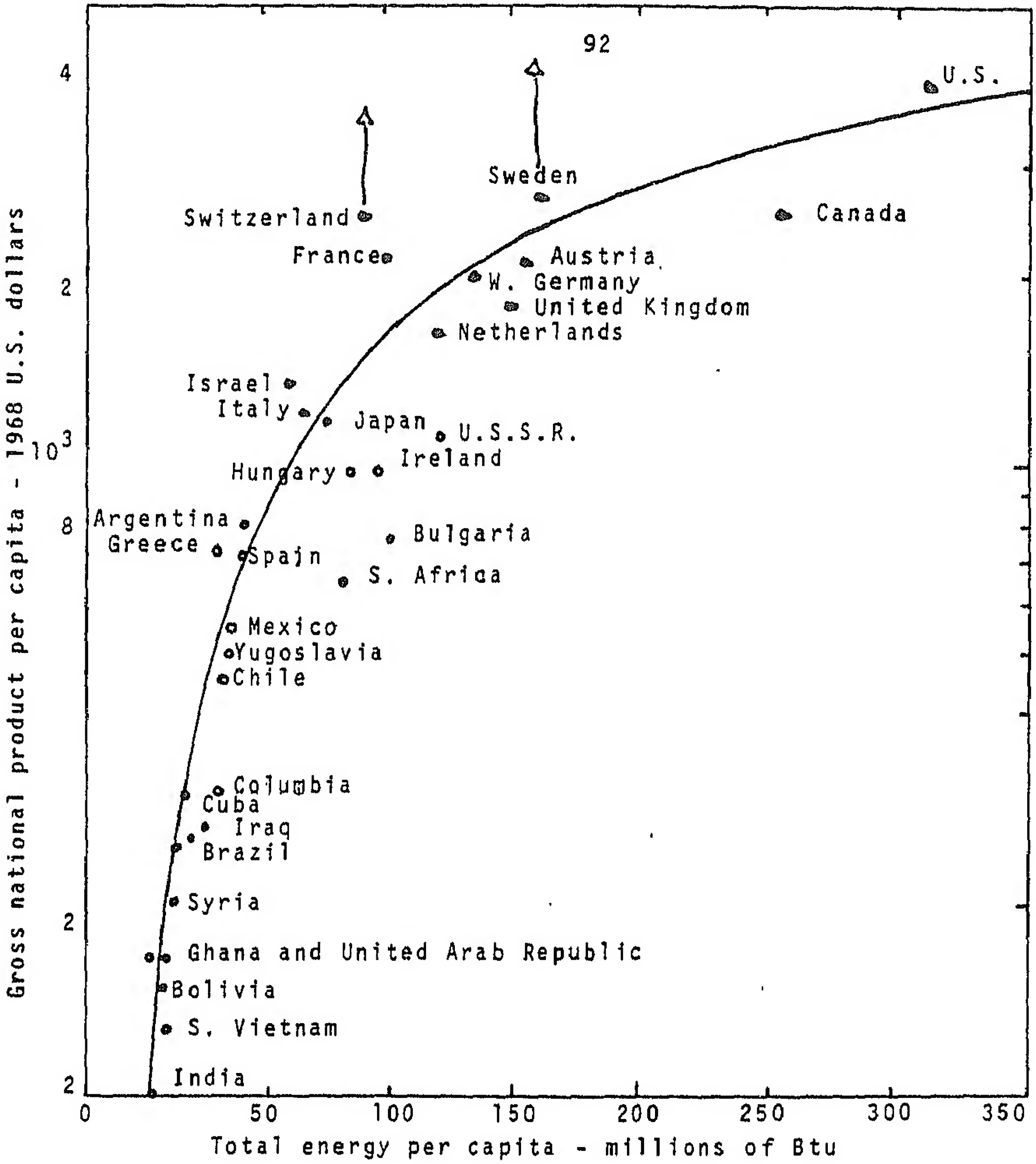
Step 5. (35 minutes)
Reconvene the groups and have them present the results of their discussions.

Trainer Notes

* Ask the recorders from each group to post and present the points covered in their discussions. After each group has made its presentation, encourage questions, comments and discussion.

* Clarify, if necessary, which issues will be addressed directly during training (i.e., fuel-saving cookstoves and the fuel wood shortage in the developing world) and which may be addressed in-country.

PER CAPITA ENERGY USE AND GNP *



* Energy per capita versus the gross national product per capita in 1968 for several nations

INTRODUCTION TO THE EVALUATION PROCESS

Total time: 2 hours

Objectives:
* To examine the way in which participants are evaluated during the program
* To identify and clarify criteria that will serve as the basis for evaluating participants during the program and for assessing their readiness and suitability for future Peace Corps service

Resources:
* Attachment I-15-A, "Self Evaluation Sheet"
* Attachment I-15-B, "Trainer Evaluation Form"
* Attachment I-15-C, "Explanatory Notes on the Evaluation and Selection Process"

Materials: Newsprint and felt-tip pens

Trainer Notes

It is important that staff members participate in this session so that decisions concerning the evaluation are mutually understood and accepted by both staff and participants from the start of the program.

Step 1. (10 minutes)
Review the session objectives.

Trainer Notes

Explain that throughout the program each participant will be evaluated based on the knowledge, skills, behavior and attitude that will be important during Peace Corps service. The essence of the evaluation system is that all who take part in the program -- staff and participants alike -- also share in the process of defining and using the criteria for effective Peace Corps work.

Also stress that the evaluation process will emphasise self evaluation on the part of all participants.

Step 2. (20 minutes)
Distribute Attachment I-15-C, "Explanatory Notes on the Evaluation and Selection Process," and allow time for reading and questions.

Trainer Notes

cluded in Attachment I-15-C is an outline of the evalua-
ocess as it occurs throughout training. This may be
reference material for the trainer or made available
cipants as well.

Step 3. (10 minutes)
Distribute Attachment I-15-A, "Self Evaluation Sheet," and Attachment I-15-B, "Trainer Evaluation Form," and review them.

Trainer Notes

that the criteria in each of the four categories have
eloped during other training programs and are intended
es that may be used as guidelines during the next step
people develop their own criteria or modify the exist-
.

Step 4. (30 minutes)
Have the participants form four groups (one for each major evaluation category: communication, commitment, technical and cognitive) and develop on newsprint a list and explanation of the criteria that they believe are important as a basis for evaluation in that particular category.

Trainer Notes

oup should include representatives from both staff and
to insure that there is active involvement by all who
icipating in the training program.

the criteria from the sample form are used, modified
here should be ample time allotted for discussion
roup can arrive at an agreement about the criteria
It is possible that the group will accept the sam-
n criteria and all that will be necessary is a
finition of the terms already listed.

Step 5. (45 minutes)
Reconvene the large group and have a representative from each group post and explain their criteria list

Trainer Notes

r category, the participant explaining his/her
ria list should make any necessary modifications,
deletions such that the entire group agrees upon

Step 6. (5 minutes)
Explain that the final criteria lists developed in this session will be used by the staff in completing "Trainer Evaluation Forms" and should be used by the participants in completing their "Self Evaluation Sheets" at the end of each evaluation period.

Trainer Notes

The criteria lists should be typed and transferred to the "Self Evaluation Sheets" and the "Trainer Evaluation Forms" before the end of the first evaluation period.

The written explanations for each criteria should be typed separately and distributed to all participants and staff as a reference aid.

SELF EVALUATION SHEET

Name: ______________________ Phase: ______________

Criteria/Trainee Comments	Be specific and give examples to support your comments. Provide suggestions for self improvement.

COMMUNICATION SKILLS

* Active Listening
* Clarity of Expression/Thought
* Versatility
* Feedback
* Role Flexibility
* Patience
* Effective Facilitation

COMMITMENT TO PROGRAM

* Positive Motivation
* Enthusiasm
* Taking Responsibility for Oneself and Program
* Punctuality
* Willingness to Change/Adapt
* Cooperation & Mutual Support
* Active Participation
* Self Assessment
* Sincerity

Name: ________________ Phase: ________________

Criteria/Trainee Comments	Be specific and give examples to support your comments. Provide suggestions for self improvement.

TECHNICAL COMPETENCE

* Resourcefulness
* Processes
* Results
* Understanding
* Transfer of Skills

COGNITIVE SKILLS

* Problem Solving
* Understanding Development Ideas
* Cross-Cultural Awareness
* Application of Experiential Learning
* Awareness of Strengths and Weaknesses
* Observation Skills
* Organizational Skills

Name: ______________________ Phase: ____________

Criteria/Staff Comments	Be specific and give examples to support your comments. Provide suggestions for improvement.

COMMUNICATION SKILLS

* Active Listening
* Clarity of Expression/Thought
* Versatility
* Feedback
* Role Flexibility
* Patience
* Effective Facilitation

COMMITMENT TO PROGRAM

* Positive Motivation
* Enthusiasm
* Taking Responsibility for Oneself and Program
* Punctuality
* Willingness to Change/Adapt
* Cooperation and Mutual Support
* Active Participation
* Self Assessment
* Sincerity

Name: ______________________ Phase: ______________

Criteria/Staff Comments	Be specific and give examples to support your comments. Provide suggestions for improvement.

TECHNICAL COMPETENCE

* Resourcefulness

* Processes

* Results

* Understanding

* Transfer of Skills

COGNITIVE SKILLS

* Problem Solving

* Understanding Development Issues

* Cross-Cultural Awareness

* Application of Experiential Learning

* Awareness of Strengths and Weaknesses

* Observation Skills

* Organizational Skills

EXPLANATORY NOTES ON THE EVALUATION AND SELECTION PROCESS

The essence of this program is to help you develop the skills and knowledge that will be necessary during Peace Corps service. For this reason we emphasize the importance of on-going evaluation. Such evaluation is essential to making any recommendation about your readiness and suitability for Peace Corps service.

Remember: you are not yet a Peace Corps Volunteer and it is your participation in this program that will help you and the training staff determine whether or not Peace Corps is the right direction for you at this time. We encourage you to take an active role in the process: from identifying the criteria that will be used to evaluate you, to taking part in the evaluation of your knowledge, skills, attitudes and characteristics that are relevant to future Peace Corps service.

The evaluation process includes a number of steps and is intended to provide staff and trainees with some tools for examining your growth and readiness. The decision to leave the program can be made at any point during training, either by you or by the training staff. Any decision of this kind should be mutual and based on an honest, open self appraisal.

The format and implementation plan of this evaluation and selection process consists of the following:

A. Skills and Knowledge Assessment Sheet

   1. Purpose
      To provide you and the training staff with an understanding of the skills and knowledge you bring to the program

   2. Implementation
      To be distributed and completed during the first week of the program

B. Introduction to Training Manual and Training Goals

   1. Purpose
      To provide you with an understanding of the goals and methodology of the training program

   2. Implementation
      To be distributed and explained during the first week of the program

C. Training Expectation List

1. Purpose
To enable you to clarify your expectations regarding the training program and to enable the training staff to clarify its expectations

2. Implementation
To be developed in a structured activity during the first week of the program

D. Peace Corps Service Expectation List

1. Purpose
To enable you to clarify your expectations regarding Peace Corps service as a volunteer

2. Implementation
To be developed in a structured activity during the second week of the program

E. Trainee Evaluation Criteria

1. Purpose
To provide you and the training staff with a basis for assessing your ability to acquire the skills necessary for successful Peace Corps service

2. Implementation
To be carried out through the use of the following multiple techniques and indicators:

a. Trainer Evaluation Forms
To include trainee evaluation criteria lists. They are designed to be completed by the training staff at the end of each phase of training

b. Self Evaluation Forms
To include the same components as the Phase Evaluation Forms and to be completed by you at the end of each phase of training

F. Counterpart Sessions

1. Purpose
To provide you and the training staff with the opportunity to share perceptions of your progress regarding levels of skills acquisition and to discuss strengths and weaknesses in a mutually supportive and constructive environment

2. Implementation
To be conducted at the end of each phase of the program on a one-to-one trainee/staff basis with completed Trainer Evaluation Forms and Self Evaluation Sheets serving as a basis for discussion

G. Final Written Statement of the Role of Volunteer in Development

1. Purpose
To provide you and the training staff with a final written statement of your perceptions of your role as a Peace Corps volunteer

2. Implementation
To be completed during Phase VI of the training program

H. Final Skills and Knowledge Assessment Sheet

1. Purpose
To provide you and the training staff with an understanding of any new skills and knowledge you acquired during the training program

2. Implementation
To be distributed and completed during Phase VI of the training program

J. Final Interview

1. Purpose
Based on the culmination of all completed evaluation techniques and indicators, to provide you and the training staff the opportunity to discuss your overall readiness and suitability for Peace Corps service and to arrive at a final, mutually-negotiated decision regarding your invitation for Peace Corps service

2. Implementation
To be conducted during the final week of training

K. Final Written Recommendation

1. Purpose
To provide you, the training staff and Peace Corps with a final written statement of your level of skills development and an over-all recommendation regarding your invitation to enter Peace Corps service

2. Implementation
To be completed and negotiated mutually during final interviews

PHASE I	P	PHASE III	PHASE IV	PHASE V	PHASE VI
Introduce the evaluation process Complete Skills and Knowledge Assessment Sheets Introduce the training manual and program goals Identify expectations of training program Develop trainee evaluation using Trainer Evaluation Forms and Self Evaluation Sheets Conduct counterpart Sessions to discuss written evaluations	D e l p s D w e u T a- t a S t Conduct counterpart sessions to discuss written evaluations	Develop written trainee evaluations using Trainer Evaluation Forms and Self Evaluation Sheets Conduct counterpart sessions to discuss written evaluations	Develop written trainee evaluations using Trainer Evaluation Forms and Self Evaluation Sheets Conduct counterpart sessions to discuss written evaluations	Develop written trainee evaluations using Trainer Evaluation Forms and Self Evaluation Sheets Conduct counterpart sessions to discuss written evaluations	Complete final written statement of the role of the volunteer in development Complete Final Skills and Knowledge Assessment Sheets Conduct final interviews to review all evaluations and discuss final invitation to Peace Corps service Complete final written recommendation stating over-all levels of skills development and final invitation to Peace Corps service

NOTE: It is important to consistently carry out all the components of the trainee evaluation process in an on-going fashion throughout the program. This brief schematic outline indicates the major components of the process as they should occur in each phase.

EVALUATION AND INTEGRATION OF TRAINING THEMES
PART ONE: THE PHASE EVALUATION QUESTIONNAIRE

Total time: 30 minutes

Objectives:
* To evaluate the effectiveness of the past phase of training
* To give feedback to the staff about the program to date

Resources: Attachment I-16/1, "Phase Evaluation Questionnaire"

Trainer Notes

Before the session, prepare and post on newsprint:
* A chronological list of sessions from the phase being evaluated
* A list of trainers who participated in the phase

Procedures: Step 1. (5 *minutes*)
Introduce the evaluation process, post the list of sessions and distribute the evaluation questionnaire.

Trainer Notes

Explain that the questionnaire will be used throughout training. It provides an opportunity for people to communicate their thoughts about the effectiveness of sessions and of the training staff and to make suggestions for improvement.

Point out that participants need not sign their names to the questionnaires.

Step 2. (10 minutes)
Have participants complete Part I of the questionnaire, using the list of sessions as a guide.

Step 3. (10 minutes)
Have participants complete Part II of the questionnaire, using the list of trainers as a guide.

Step 4. (5 minutes)
Collect the completed questionnaires and explain how they will be used.

Trainer Notes

Emphasize that this evaluation process will be repeated at the conclusion of each phase of the training. Let the participants know the information provided by the questionnaires will be used by the staff to modify and improve the training program.

PHASE EVALUATION QUESTIONNAIRE

This questionnaire provides us with ongoing information we can use to increase the effectiveness of the training. We would appreciate your thoughtful consideration in making specific comments to tell us why an activity was useful or why it was not as useful as it might have been.

Part I: Sessions

List training activities in the order indicated by your instructor. Next rate their usefulness by circling a number on the scale.

Session Title	Not Useful		Moderately Useful		Very Useful
1. ______________________	1	2	3	4	5
Comments: ______________________					
2. ______________________	1	2	3	4	5
Comments: ______________________					
3. ______________________	1	2	3	4	5
Comments: ______________________					
4. ______________________	1	2	3	4	5
Comments: ______________________					
5. ______________________	1	2	3	4	5
Comments: ______________________					
6. ______________________	1	2	3	4	5
Comments: ______________________					
7. ______________________	1	2	3	4	5
Comments: ______________________					
8. ______________________	1	2	3	4	5
Comments: ______________________					

Session Title	Not Useful		Moderately Useful		Very Useful
9. ____________	1	2	3	4	5
Comments:					
10. ____________	1	2	3	4	5
Comments:					
11. ____________	1	2	3	4	5
Comments:					
12. ____________	1	2	3	4	5
Comments:					
13. ____________	1	2	3	4	5
Comments:					
14. ____________	1	2	3	4	5
Comments:					
15. ____________	1	2	3	4	5
Comments:					
16. ____________	1	2	3	4	5
Comments:					
17. ____________	1	2	3	4	5
Comments:					
18. ____________	1	2	3	4	5
Comments:					
19. ____________	1	2	3	4	5
Comments:					
20. ____________	1	2	3	4	5
Comments:					

Part II: Trainers

List the name(s) of your major trainer(s) in the blanks provided and comment on the overall effectiveness during this week. Use the following points for consideration:

* Ability to effectively communicate information
* Apparent knowledge of subject matter
* Ability to integrate the major components of training, e.g., technical, health and nutrition, women in development, extension, cross-cultural and role of volunteer in development
* Methodology (flexibility, adult learning principles, etc.)

Name: ____________________ Comments: ____________________

Name: ____________________ Comments: ____________________

Name: ____________________ Comments: ____________________

Name: ____________________ Comments: ____________________

Name: ____________________ Comments: ____________________

Name: ____________________ Comments: ____________________

Name: ____________________ Comments: ____________________

art III: Participation

o you feel that you have participated in the discussions to the
xtent that you wanted? ( ) Yes ( ) No

n you feel that other participants have had an equal opportunity
c contribute to the discussions? ( ) Yes ( ) No

omments: ____

____

____

____

eflect on this week and pick out the three most important things
ou have learned (such as a particular content, an insight, an
nteraction, a process, something shared, etc.) and write them
n the blanks provided.

. ____

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. ____

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ist any difficulties or problems with the training to date and
ggest how they might be corrected.

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EVALUATION AND INTEGRATION OF TRAINING THEMES
PART TWO: EXAMINATION OF TRAINING THEMES

Total time: 30 minutes

Objectives:
* To identify and discuss the major themes of the training program
* To examine how the themes of the program are related to one another

Resources: Chronological list of sessions from the past phase (see Part One of this session)

Materials: Newsprint and felt-tip pens in different colors

Procedures: Step 1. (10 minutes)
Refer to the posted list of sessions and ask the participants to identify the major themes of training. Record their responses on newsprint.

Trainer Notes

If necessary, provide an example or two of the training themes that appear in the introduction to this manual.

Step 2. (10 minutes)
Have the participants form groups of 4 or 5 and, on newsprint, develop a visual representation of the way the training themes relate to one another.

Trainer Notes

Encourage the groups to make their representation as detailed and creative as possible. If necessary, provide an example.

Step 3. (10 minutes)
Have the groups reconvene and present and discuss their visual representations.

Trainer Notes

Some questions for discussion include:

* Is there a need for more technical training at this time?
* Why is a health and nutrition component included in training?
* What importance do facilitation and communication skills have in this program and during Peace Corps service?
* How is this program similar to or different from your expectation?

IATION AND INTEGRATION OF TRAINING THEMES
THREE: THE FISHBOWL -- AN EXERCISE IN COMMUNICATION

time: 1 hour

tives:
* To establish open and positive communication among training staff and participants
* To practice giving and receiving feedback

ials: Newsprint and felt-tip pens

Trainer Notes

suggest that one of the trainees facilitate this session. is a good opportunity to encourage active participation to demonstrate staff willingness to "let go" and be re-tive to feedback.

dures:

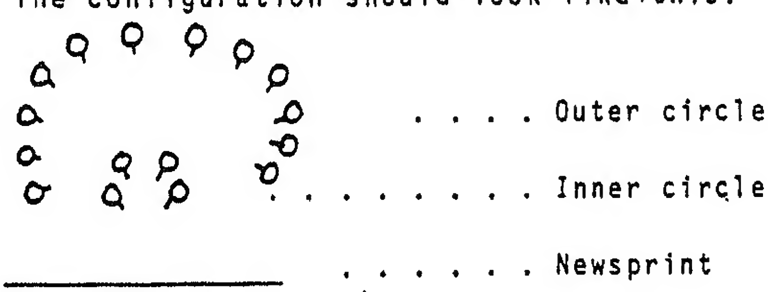
Step 1. (5 minutes)
Review and explain the session objectives.

Step 2. (15 minutes)
Have people form groups of 4 or 5 and:
* Record on newsprint three criticisms of the program and, for each criticism, a specific suggestion as to how the program could be altered to address it.
* Post the criticisms and suggestions.

Trainer Notes

is important that the entire training staff participate in s activity. Each small group should include at least one ff member.

le the small groups are working, arrange chairs in a semi-cle at the front of the room so that four people can face speak to one another while reading the posted criticisms suggestions. Arrange a second row of chairs around the st four. The configuration should look like this:



Step 3. (10 minutes)
Have the group reconvene and occupy the chairs in the outer semi-circle. Explain the "Fishbowl" activity.

Trainer Notes

Ask if anyone has had experience with this activity. If so, ask them to help you with the explanation. Your explanation should include the following points:

* Only four people at a time will be in the inner semi-circle.
* The role of each of the four people will be to discuss and respond to the posted criticisms and examine the feasibility of the suggestions.
* The role of those in the outer semi-circle will be to observe.
* When someone from the outer circle wants to enter the discussion, a person from the discussion group should leave and join the observers.

The reason for using the fishbowl structure is to provide a comfortable format for discussion and to encourage constructive feedback and suggestions. Therefore, it is important that people feel free to express their thoughts without fear of reprisal. People should be encouraged to enter the discussion and to exchange places with one another when they have something to say. It is a good idea to have at least one member of the training staff in the discussion group at all times.

Step 4. (25 minutes)
Ask that four volunteers move to the inner semi-circle and initiate the activity by responding to one of the criticisms.

es)
ticisms and suggestions that have
s activity, and explain that the
ay be used at any time during
people feel it is necessary to
lear the air or evaluate some
gram.

Notes

uation and assessment of the
series of integrated activities
gram. This session outlines the
ed for Phase I. It also
Continued

Trainer Notes

identifies those activities which should occur at the end of each subsequent phase (i.e., the evaluation questionnaires and the optional fishbowl activity). Other recommended program evaluation activities are outlined in Phase III, "Mid-Program Evaluation," and Phase VI, "Final Program Evaluation" and "Energy Fair Evaluation." In order to insure effective on-going program evaluation, it is important to be consistent and use the recommended activities at the end of each phase.

The outline on the following page is designed to help you remember the program evaluation activities which should occur in each phase of the program.

OUTLINE OF PROGRAM EVALUATION ACTIVITIES

PHASE I	PHASE II	PHASE III	PHASE IV	PHASE V	PHASE VI
Presentation of Phase Evaluation Questionnaire Develop training expectation lists Integration of training themes Feedback and discussion/ fishbowl exercise	Phase Evaluation Questionnaire Fishbowl exercise (optional)	Phase Evaluation Questionnaire Mid-Program Evaluation: Review and assess expectation lists Complete Mid-Cycle and Final Evaluation of Training Goals forms Fishbowl exercise (optional) Assessment of group dynamics: Coat of Arms activity	Phase Evalution Questionnaire Fishbowl exercise (optional)	Phase Evaluation Questionnaire Fishbowl exercise (optional)	Final Program Evaluation: Mid-Cycle and Final Evaluation of Training Goals forms (PCT facilitator) Energy Fair Evaluation: Success Indicator Lists (PCT facilitator)

SESSION 10

EYE HOOK AND LINK: TECHNOLOGY TRANSFER

Total Time: 3 hours

Objectives:
* To make an eye hook
* To make a lap joint link
* To practice techniques used in transferring blacksmithing skills to local blacksmiths

Resources:
* Andrews, pages 54-57.

Materials: Newsprint, felt-tip pens, approximately 25-30' of 1/2" coil spring or round bar; 25-30' of 3/8"-5/16" round bar.

Trainer Notes

Steps 7-9 of this session involve having the participants role-play local blacksmiths. An effective option to this role-play situation would be to invite a few local blacksmiths to observe the demonstrations and ask questions, make comments, etc.

Procedures:

Step 1. (5 minutes)
Explain the session objectives and briefly outline the procedures.

Step 2. (20 minutes)
Have the participants form their work teams and uncoil and cut two 12" lengths of coil spring.

Trainer Notes

* Circulate among the teams and offer advice and assistance whenever necessary.
* It is important to allow participants to work as independently as possible so that they can practice and sharpen their skills.

Step 3. (20 minutes)
Reconvene the group and demonstrate the proper techniques and procedures for making an eye hook and lap link.

Trainer Notes

* Before beginning the demonstration, briefly explain the procedures to be followed and remind participants to observe carefully.

Continued

Trainer Notes/Continued

* During the demonstration, mention and point out the following important techniques:

  - calculating materials necessary for eye hook and link
  - forging a small eye by wrapping it around bar stock
  - tapering the hook end
  - bending of hook end to complete eye
  - forging of lap joints on link stock
  - bending of stock into link

* Following the demonstration, take a few minutes to ask participants to review and clarify the techniques which they observed.

Step 4. (5 minutes)
Divide the work teams into two groups and explain that Group #1 will make eye hooks while Group #2 will be making lap joint links.

Trainer Notes

Explain that each team in Group #1 should make one eye hook using one piece of straightened spring (or ½" round bar) and that each team in Group #2 should make one lap link using one piece of 3/8" or 5/16" round bar or spring.

Step 5. (40 minutes)
Have the teams work on their eye hooks or links.

Trainer Notes

Offer guidance whenever necessary and point out any potentially unsafe practices which may occur.

Step 6. (10 minutes)
Reconvene the group and ask participants to identify and discuss factors which should be considered when planning to communicate technical skills and new forging practices to local blacksmiths.

Trainer Notes

* Write their responses on posted newsprint

* Stimulate discussion and participation by asking:

  - What kinds of communication aids would be appropriate for local blacksmiths (i.e., models, prototypes, pictures, etc.)

  - What techniques could be used to stimulate the interest, cooperation, and participation of local blacksmiths?

  - What techniques could be used to overcome cultural barriers which may exist between local blacksmiths and foreign development workers?

  - How could local traders and farmers benefit from an availability of rings, hooks, or links?

Step 7. (5 minutes)
Explain the procedures and roles for the demonstratio activity.

Trainer Notes

* Explain that Group #1 will present a demonstration of the proper procedures for making an eye hook while Group #2 observes and takes the role of local blacksmiths. Then, Group #2 will demonstrate the proper method of making an overlap link while Group #1 observes and role-plays local blacksmiths.

* Point out that each demonstration should last approximately 20 minutes and should include time for questions from the observers.

Step 8. (15 minutes)
Have the participants form the two groups and prepare for their demonstrations.

Trainer Notes

As the groups are working, circulate among them and remind them of the factors which they identified in Step 6.

Step 9. (45 minutes)
Have each group present their demonstration.

Trainer Notes

During each demonstration, it is important that the trainer take the role of a local blacksmith and that he/she set the climate and tone of the role-play situation by asking questions which relate to the list of factors discussed in Step 6.

Step 19. (15 minutes)
Ask the participants to discuss each demonstration and evaluate its effectiveness as a means of transferring skills to local blacksmiths.

Trainer Notes

Stimulate discussion by asking:

- What aspects of the demonstrations were particularly effective? Why?
- How could those aspects of the demonstrations which seemed ineffective be improved?
- Which techniques seemed easy to demonstrate? Why?
- Which techniques seemed difficult to demonstrate? Why?

FORGING RINGS

Total Time: 1 hour

Objectives:
* To practice cold-cutting
* To forge rings

Materials: Approximately 20-25' of 3/8"-5/16" mild steel round bar.

Procedures: Step 1. (5 minutes)
Explain the session objectives and briefly outline the procedures.

Trainer Notes

Explain that the rings forged during this session will be used to practice brazing in Session 11.

Step 2. (10 minutes)
Have the participants divide into their work teams and cold-cut two 10" lengths of 1/2" round bar.

Trainer Notes

* As the teams are working, provide assistance when necessary by reminding them of the cold-cutting techniques demonstrated in Session 4.

* Again, stress the importance of the proper use of the cold cutter and cutting plate to protect the face of the anvil.

Step 3. (10 minutes)
Reconvene the group and demonstrate the proper techniques involved in forging a ring and lap.

Trainer Notes

* During the demonstration, point out the following techniques:

  - heating of stock to proper color/temperature
  - forming of lap
  - hammering - use of anvil horn to form ring
  - determining the proper length of the stock

* Have them identify and discuss those techniques which are common to the making of an eye hook or link.

Step 4 (30 minutes)
Have participants return to their work stations and forge two rings per team.

Trainer Notes

* Provide assistance and suggestions whenever necessary.

* As teams finish forging their rings, have them assist others who may be experiencing difficulty.

Step 5. (5 minutes)
Reconvene the group and ask participants to discuss and share among themselves any difficulties they experienced and how they overcame them.

WELDING PRACTICES: FORGE BRAZING

Total Time: 1½ hours

Objectives:
* To identify and discuss various types of welding processes
* To discuss welding processes used by local blacksmiths
* To forge braze rings

Materials: Forged rings from Session 10, flux, brass rods, an assortment of examples of various types of welds, electric arc, gas forge, flux spoon, etc.

Trainer Notes

Prior to this session, it will be necessary to assemble and prepare for distribution a collection of examples of various types of welds (see Trainer Notes, Step 2).

Procedures: Step 1. (5 minutes)
Briefly explain the session objectives and ask participants to define welding.

Trainer Notes

* Point out that there are several ways to weld but that, essentially, the process is one of bonding metal together using heat.
* Also, explain that brazing and soldering are welding methods that require the use of a third metal as a binder.

Step 2. (15 minutes)
Distribute examples of various types of welds and ask the participants to describe the methods used in each case and to discuss why one method may be preferable to another.

Trainer Notes

* Among the examples distributed, be certain to include demonstration samples of forge welding, gas and electric welding, brazing and soldering.
* In discussing each type of weld, ask participants who have had experience with welding to:
  - identify and name the type of weld
  - describe the process involved and the equipment necessary

Continued

Trainer Notes/Continued

- give examples of how and where each type is most often used:
- discuss fluxes, bonding metals and temperatures
- explain why one type of weld may be preferable to another
- Describe various kinds of joints (i.e., lap, but, vee)

Step 3. (10 minutes)
Ask participants to describe forge welding and brazing processes they have seen local blacksmiths use.

Trainer Notes

* Some questions to stimulate discussion include:

  - What similarities/differences exist between processes used by local blacksmiths and those discussed here?

  - What cultural and/or economic factors influence the welding practices of local blacksmiths?

Step 4. (10 minutes)
Explain that forge brazing is the type of welding which will be practiced during this session and ask participants to discuss its potential use by local blacksmiths.

Trainer Notes

* Remind participants of the discussion from the previous steps and have them describe and explain why braze welding could be a viable technique for local blacksmiths.

* Ask them to identify some local uses for braze welds (e.g., repairing).

Step 5. (15 minutes)
Demonstrate the procedures involved in braze welding a ring.

Trainer Notes

* During the demonstration, it is important to point out and explain the following techniques:

  - cleaning of joint with wire brush after heating and before fluxing
  - proper control of heat
  - placement of flux
  - use of the flux spoon

Continued

Trainer Notes/Continued

- placement and handling of brass rod
- testing the weld for strength
- determining when brazing heat has been reached
- results of over-heating

* Before proceeding to the next step, be certain that participants understand the procedures and techniques involved.

Step 6. (25 minutes)
Have the participants go to their work stations and forge braze the lap rings that they made in the previous session.

Trainer Notes

Provide assistance and suggestions whenever necessary.

Step 7. (10 minutes)
Reconvene the group and have them discuss the brazing activity.

Trainer Notes

* Have work groups describe any difficulties which they experienced and share ideas about ways to overcome them.

* Depending on the amount of time remaining in the session, it may also be useful to demonstrate how forge brazing can be used to repair a broken tool or implement.

OPEN WORKSHOP: MID-PROGRAM REVIEW

Total Time: 2½ hours

Objectives:

* To assess levels of skills acquisition at this point in the training
* To evaluate the effectiveness of the training design and implementation to date
* To work independently at forges
* To finish incompleted projects
* To practice basic blacksmithing skills

Materials: Newsprint, felt-tip pens, assorted scrap steel, round bar, flux, brass rods, etc.

Trainer Notes

* Prior to this session, it will be necessary to:
  - write on newsprint a list of the basic blacksmithing techniques practiced up to this point in the training (see Step 2)
  - assemble an ample supply of the equipment and materials necessary to practice these techniques (see Step 4).

Procedures:

Step 1. (5 minutes)
Explain the session objectives and outline the procedures.

Trainer Notes

* Remind participants that this is the mid-point of the training and that it is useful to spend time reflecting upon and evaluating the effectiveness of the program to date.
* Explain that participants should take this opportunity to suggest ways in which the program could be improved so as to take better advantage of the days remaining.

Step 2. (20 minutes)
Ask participants to briefly review and describe the basic blacksmithing techniques which have been practiced up to this point in the training.

Trainer Notes

* Post on newsprint a list of basic techniques practiced to date, including:

  - fire building
  - fire maintenance
  - safety procedures
  - heating
  - hammering
  - drawing out
  - cutting (hot and cold)
  - bending
  - upsetting
  - punching
  - grinding
  - tempering
  - measuring
  - annealing
  - proper use of tools
  - brazing

* Referring to the posted list, ask the following questions:

  - With which skills do you feel most comfortable? Why?

  - Which skills do you feel you would like to practice more? Why?

* Explain that these techniques will continue to be used and practiced during the remainder of the program and encourage those participants that are comfortable with certain techniques to offer assistance to others who are not.

Step 3. (20 minutes)
Ask participants to discuss and evaluate the effectiveness of the program design and implementation to date.

Trainer Notes

* Stimulate discussion by asking:

  - Do you feel that the training has been effective in bringing out the issues and complexities involved in working with local blacksmiths? Why?

  - What training techniques has the trainer used that have been particularly helpful?

  - What could the trainer do to improve his/her training techniques?

  - Which sessions have been effective, ineffective--why?

  - What are some things that the participants could do to improve the effectiveness of the training?

* Encourage participants to be specific in their responses.

* Record on newsprint some of their suggestions and explain how they can be implemented during the remainder of program.

Step 4. (1 hour, 45 minutes)
Have participants use the remainder of the day to work independently at their forges, finishing projects and/or practicing techniques with which they may not yet feel comfortable.

Trainer Notes

* Allow participants the opportunity to finish projects or practice skills and techniques of their choosing.

* Circulate among the groups. Help to locate materials. Offer assistance whenever necessary, being careful not to intervene to the point of inhibiting the freedom of experimentation and/or independent problem-solving.

* For those participants experiencing particular difficulty with certain techniques, it may be useful to repeat some of the basic demonstrations done earlier in the training.

BELLOWS AND FORGE DESIGN

Total Time: 50 minutes

Objectives:
* To list and describe design criteria for a forge and bellows
* To evaluate forge and bellows designs
* To discuss the feasibility of introducing new forge and bellows designs to local blacksmiths

Resources:
* Attachment 13-A, "The Japanese Style Box Blower"
* Attachment 13-B, "How to Build a Blacksmith's Blowe
* Attachment 13-C, "Lorena Forge Design"
* Attachment 13-D, "Forge Pump Designs"

Materials: . Newsprint and felt-tip pens

Procedures: Step 1.
Explain the session objectives and briefly outline the procedures.

Trainer Notes

Explain that the design and construction of a bellows and forge will be only briefly discussed during this training since the design of this equipment is extremely relative to and dependent upon the needs, desires and resources of local blacksmiths.

Step 2.
Have the participants list and describe the design criteria for a bellows and forge.

Trainer Notes

* Write their responses on posted newsprint according to the example below:

Design Criteria

Bellows	Forge
ease of pumping	evenness of heat
durability	heat holding capacity
control of air blast	low cost
etc.	etc.

* Assist participants in developing the lists by providing a few examples and asking the following questions:

Continued

Trainer Notes/Continued

- Do the forges and bellows used here at the training meet the criteria? If so, how?
- Do the forges and bellows used by local blacksmiths meet these criteria?
- If not, how might they be improved?

Step 4.
Distribute Attachment 13-A, "The Japanese Style Box Blower," Attachment 13-B, "How to Build a Blacksmith's Blower," Attachment 13-C, "Lorena Forge Design," Attachment 13-D, "Forge Pump Designs," and ask participants to review them.

Step 5.
Have participants discuss the feasibility of introducing new forge or bellows designs to local blacksmit

Trainer Notes

Some questions for discussion include:

- Do the designs outlined in the Attachments offer any advantages over traditional types of forges and bellows? How?
- Do the new designs meet the criteria developed earlier in the session?
- What difficulties might you encounter in attempting to construct one of the new designs at a local blacksmith shop?

Step 6.
Conclude the session by asking one of the participants to briefly summarize the major factors which should be considered in designing a forge and bellows.

Trainer Notes

Caution participants against making recommendations regarding forge or bellows innovations without taking time to thoroughly consider the needs, desires and resources of local blacksmiths.

THE CHINESE/JAPANESE STYLE BOX BLOWER

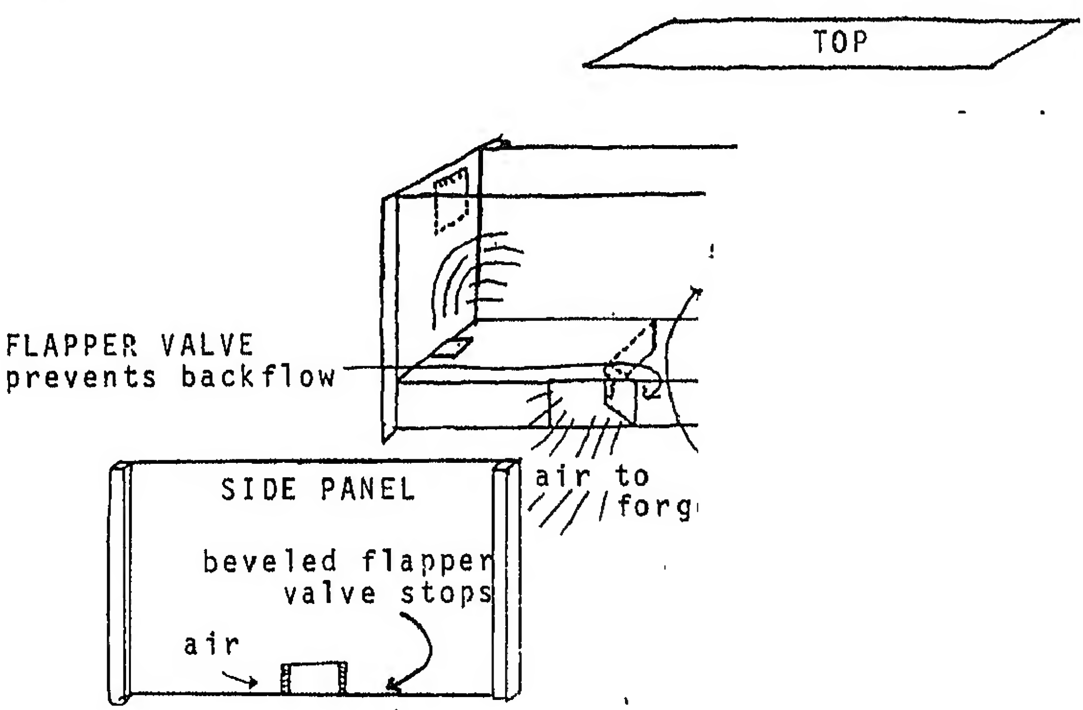
This traditional blower has been used in China and Japan for hundreds of years. It may be constructed in varying sizes. It is used in large lever-powered applications for foundries. Medium sizes (12"x18"x30") are used for forges and small versions are used for home cooking fire blowers.

Blowers may be made from almost any kind of scrap planks, if well-sealed around seams and cracks.

The inner slide chamber should be smooth and preferably waxed or varnished.

The two air inlet valves should be made of fairly heavy leather, and the hinge for the air exit flapper valve should be centered carefully. The bevel-cut on the side should align for a good seal.

It is a good idea to leave the top accessible by not sealing it with glue.

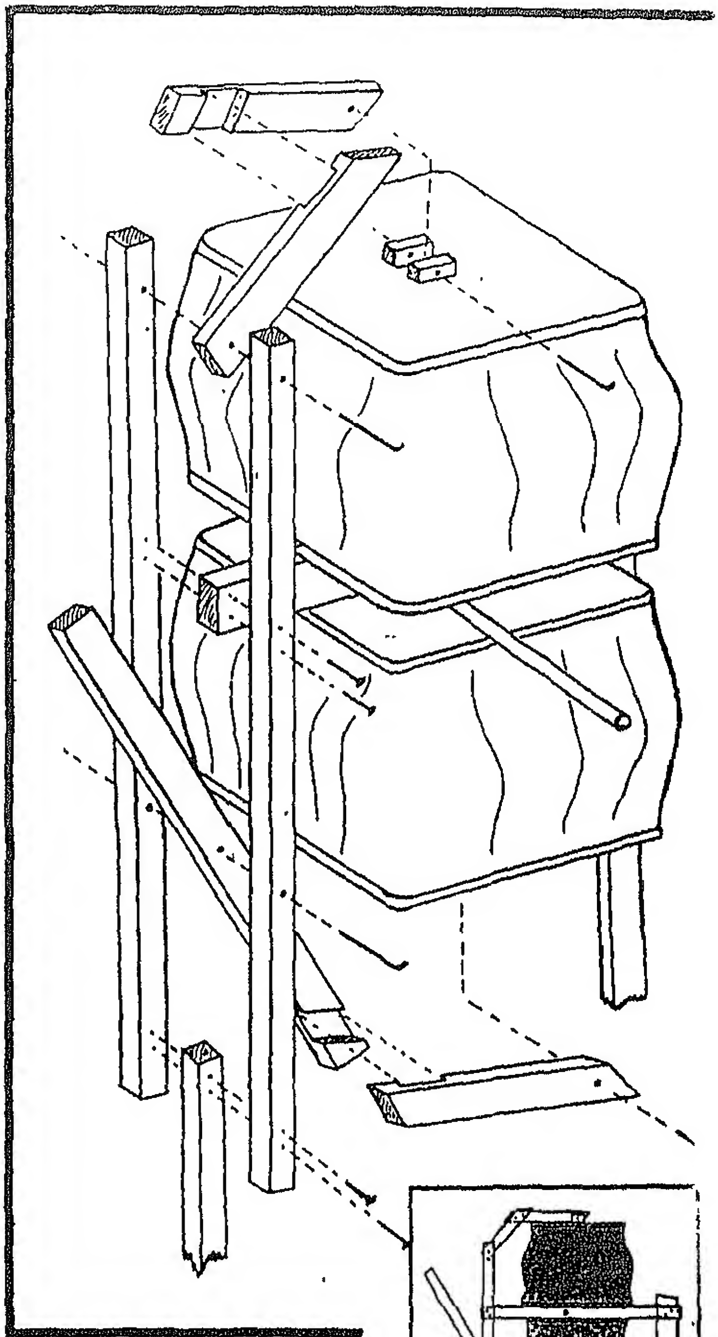


HOW TO BUILD A BLACKSMITH'S BELLOWS

Allen R. Inversin, Appropriate Tech. Development Unit, Lae, Papua New Guinea

BACKGROUND

The idea for this bellows came from the time-tested, valved, teardrop shaped design which has been in use since about the fourth century. However, as leather is not readily available in Papua New Guinea, a slightly modified version was designed using the inner tube of car tires which can be obtained anywhere in the country. The bellows cost very little to build and require no special skills for construction. It provides a continuous blast of air to the forge, which is more than sufficient to fabricate machetes, chisels, chains, hinges, spikes, etc.



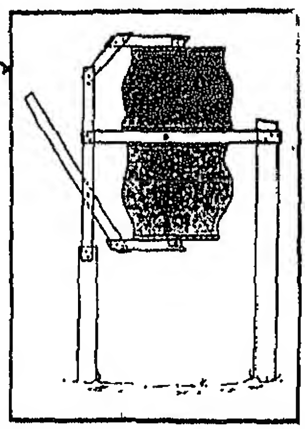
MATERIALS

- Two normal-size car tire inner tubes in good condition and one tube to cut up.
- Four 1-2 cm. boards, each about ½ m. square, of plywood or narrow boards laminated together.
- Wooden strips around 2x5 cm., totalling about 6 m. in length.
- Used steel pipe, 2-3 cm. in diameter, length 6 m. or more.
- Sheet metal or used steel banding straps.
- Four metal rods about 5 mm. in diameter and 10 cm. long.
- Nails, about 2 and 4 cm. long.

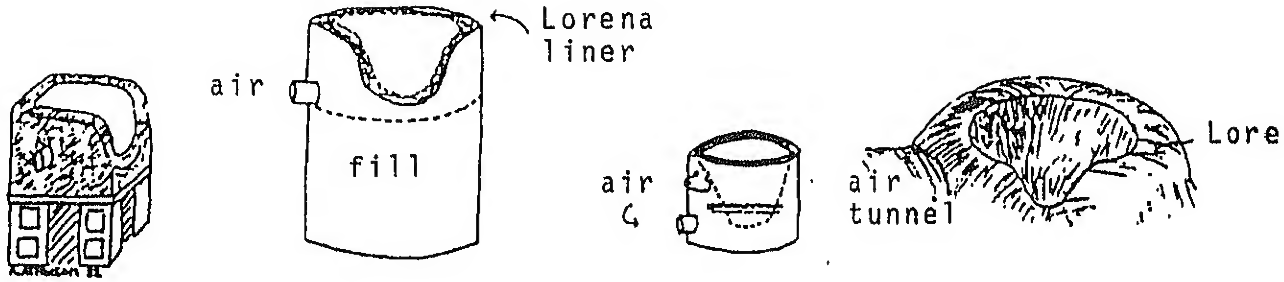
USE OF THE BELLOWS

Although they are easy to use, the bellows should be stroked in a particular way to prevent the user from becoming unduly tired. Two points should be kept in mind:

- Rather than making quick, short strokes, make smooth, full ones starting with the lower board all the way down, and stroke to compress the lower inner tube almost completely.
- The air reservoir (upper tube) should never be fully extended. If a greater air flow is needed to increase the fire temperature, place weights (pieces of iron, stones, etc.) on the upper board to obtain desired heat. Only stroke fast enough to keep the upper tube partially full at all times. A full stroke every 5-10 seconds should be sufficient; stroking any faster produces more sweat than heat.

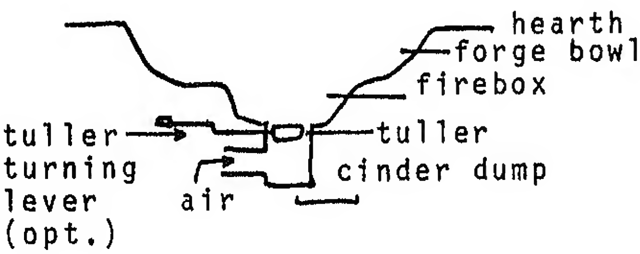


LORENA STOVE DESIGN

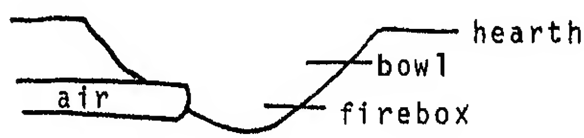


Lorena is a rammed-earth technique that uses a moist combination of screened sand and clay. The sand/clay mixture is applied in layers and pounded and compacted into molds. The primary advantages of Lorena mix include its low cost, general availability, and good heat-holding capacity. For a complete explanation of the techniques involved in working with Lorena mix, send for a copy of Lorena Stoves, by Ianto Evans and Michael Boutette, from Volunteers in Asia Press, Box 4543, Stanford, California 94305 USA.

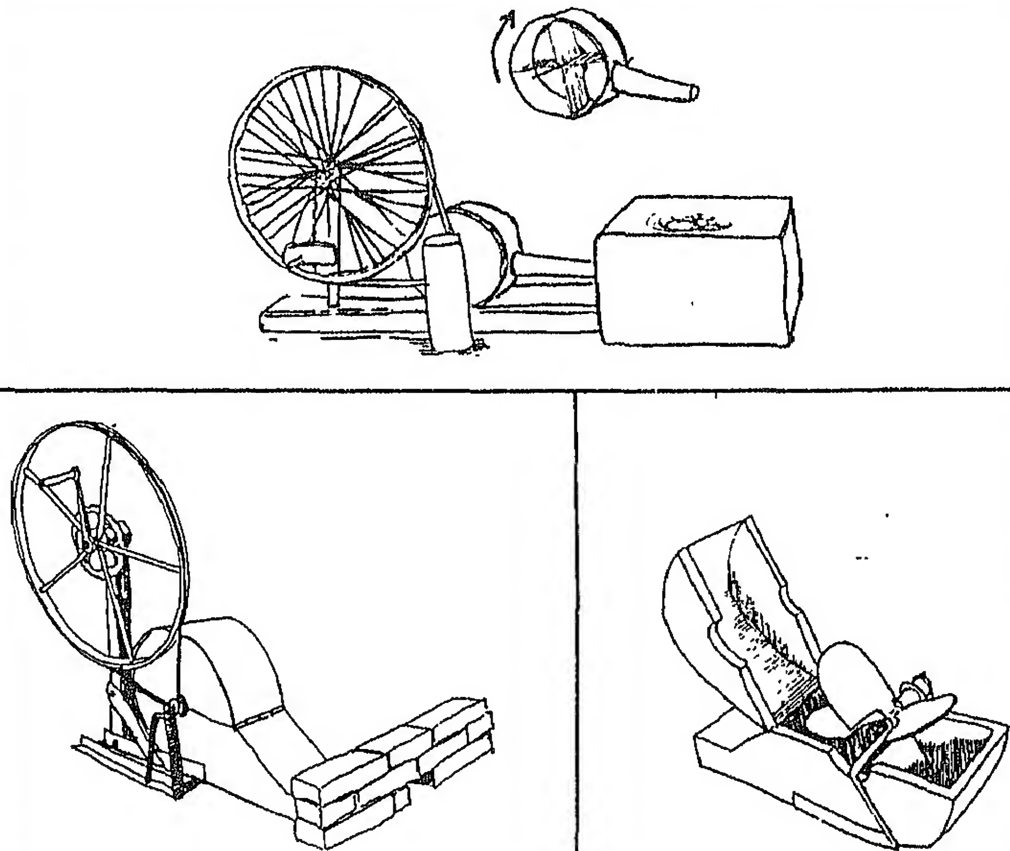
Bottom Blast Forge



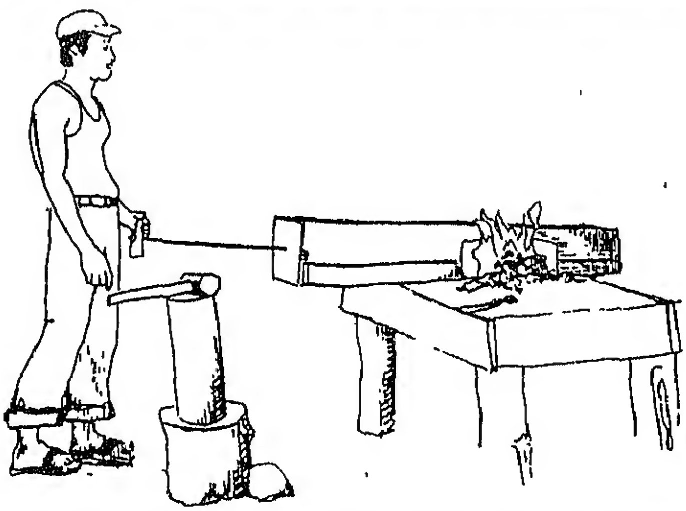
Side Blast Forge



FORGE PUMP DESIGNS



FAN-TYPE FORGE PUMPS



DOUBLE-ACTING'PISTON' FORGE PUMP

FORGING AN AFRICAN TANG-TYPE AXE

Total Time: 3 hours, 10 minutes

Objectives:
* To make an African axe
* To build endurance by working heavy metal in several consecutive heats

Resources: Attachment 14-A, "African Tang-Type Axe"

Materials: One section of leaf spring (car), ¼" thick per station; prototype axe with handle; several branches of wood suitable for handles (see Step 13).

Procedures:

Step 1. (5 minutes)
Briefly explain the objectives and pass a prototype axe among participants for observation.

Step 2. (10 minutes)
Ask the group to idenfify the metal source and components of the axe, and list on newsprint the steps involved in its production.

Trainer Notes

* Be sure the following components of the axe are mentioned in the discussion:

  - cutting edge
  - tang
  - handle

* Participants, at this point in the training, have learned and used most of the techniques involved in making an axe. As they identify the steps involved, assist only at points where new techniques are being introduced; e.g., forming the tang. Their list should include the following steps:

  - hot-cut the leaf spring
  - upset the blade end
  - partially fuller the stock
  - draw out the tang
  - cut the stock
  - finish forging the wedge tang
  - grind the blade
  - anneal
  - temper
  - make a handle and burn the axe head into the burl on the end of the handle
  - quench immediately to prevent over-burning of the tang

* Mention that in a more industrialized situation, the axe surface would be finished using a flatter, but for training purposes, this is not necessary.

Step 3. (5 minutes)
Distribute Attachment 14-A, and ask participants to refer to it as they watch the trainer's demonstrations and during their forging process.

Trainer Notes

Explain to the group that since axe forging entails considerable labor, only one axe will be made per team.

Step 4. (10 minutes)
Discuss the leaf spring as a source metal and demonstrate how to hot cut it.

Trainer Notes

* Ask for a volunteer from the group to test the leaf spring for hardness and discuss its properties.

* Have the group discuss the local availability of leaf spring and suggest alternative materials for axe-making.

Step 5. (15 minutes)
Have the teams go to their stations and hot-cut their leaf springs.

Step 6. (10 minutes)
Explain and demonstrate the upsetting of the work-piece and peening of the axe head.

Trainer Notes

Be sure to discuss the following points:

* proper techniques for using cross- and straight-peen hammers

* use of quick, light blows to keep the heat in the metal, to allow longer workability and to reduce bending.

Step 7. (30 minutes)
Have the teams upset the blades and draw-out the tangs on their axe heads.

Trainer Notes

* Circulate among the stations providing assistance when requested.

* Pay particular attention to participants' hand hold on hammers, force of blow, quickness and posture.

Step 8. (10 minutes)
Demonstrate how to finish the axe surface and forge the wedge tang.

Trainer Notes

While forging the wedge tang, mention the danger of burning the small tang in the forge.

Step 9. (20 minutes)
Have participants finish and forge the wedge tang.

Trainer Notes

Assist any teams who appear to be experiencing difficulty.

Step 10. (15 minutes)
After the teams complete the forging process, have the participants, as a group, identify problems encountered in each step and discuss possible solutions.

Trainer Notes

To provide structure to the discussion, chart their responses in the following manner on newsprint:

Step	Problem	Avoid By	Correct By
upsetting	bending, folding	light, quick hammer blows	corrective, quick straightening
etc.	etc.	etc.	etc.

Step 11. (25 minutes)
Have the teams grind and temper their axes.

Step 12. (5 minutes)
Briefly discuss the handle of the axe and demonstrate how to align and mount the axe head.

Trainer Notes

* Have the group identify suitable wood types for making handles and discuss shaping techniques.
* Explain the significance of the burl on the end in keeping the handle from splitting and adding weight to the axe.
* Mention that axes may be soaked in mud to keep handles from splitting and to keep the axe head secure.

Step 13. (30 minutes)
Have participants find suitable wood for handle-making, form the handles, and mount their axe heads.

Trainer Notes

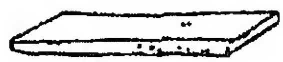
* If appropriate wood types are available in the vicinity, ask the teams to explore the area and find branches from which to form the handles.

* If wood is sparse, provide the group with several pieces of raw material from which to choose.

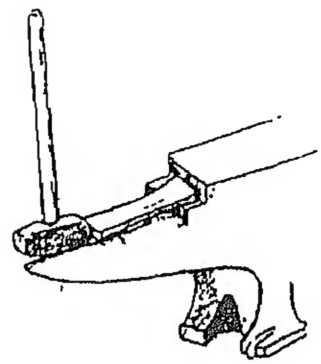
STEP BY STEP ILLUSTRATION OF AXE-MAKING PROCEDURES

African Tang-Type Axe

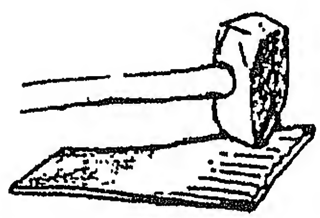
1. Material



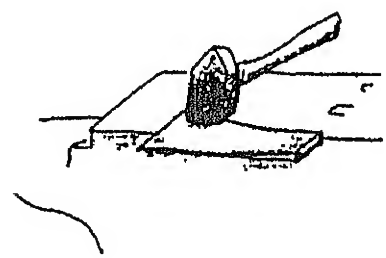
2. Upsetting



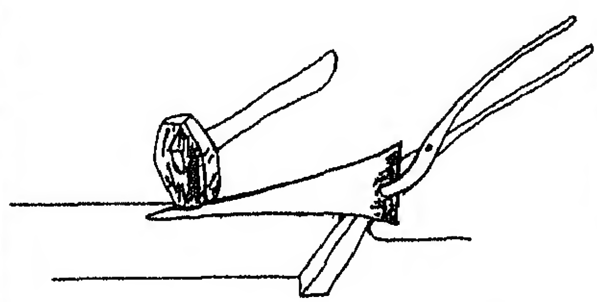
3. Spreading



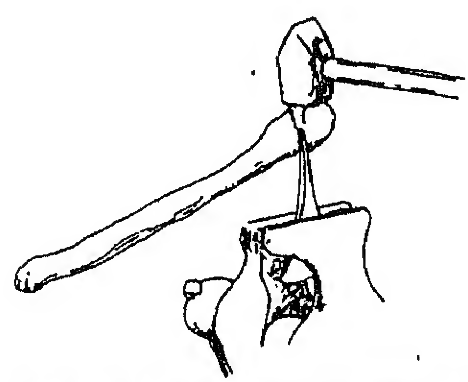
4. Drawing Out Edge



5. Drawing Out Tang



6. Mounting Handle



CASE-HARDENED AFRICAN FIELD HOE WITH COLLAR

Total Time: 4 hours

Objectives:
* To forge a field hoe with collar
* To discuss case hardening as an alternative to tempering
* To case harden a field hoe
* To examine difficulties encountered by local blacksmiths in making agricultural tools

Resources:
* Attachment 15-A, "African Field Hoe"
* Andrews, pages 119-122.

Materials: One completed field hoe, one piece of field hoe materi ready for swaging, one field hoe ready for case hardening, carburizing agent, approximately 20 square feet of 1/8" mild steel.

Trainer Notes

* Preparation for this session will involve:
  - completing one prototype field hoe (see Step 2)
  - completing one hoe up to the point of fullering (see Step 4)
  - completing one hoe such that it is ready to be case hardened (see Step 7)

Procedures: Step 1. (5 minutes)
Explain the session objectives and briefly outline the procedures.

Trainer Notes

Explain that there are many different designs of field hoes which vary greatly from country to country. The design used in this session is meant to provide participants with the basic steps involved in making a hoe and may not necessarily be appropriate to their work sites.

Step 2. (10 minutes)
Distribute Attachment 15-A, "African Field Hoe." Pass around a sample field hoe and ask that participants examine it carefully and think about the procedures involved in forging it.

Trainer Notes

Point out that the procedures illustrated in the attachment can serve as a guide.

Step 3. (15 minutes)
Ask participants to describe the steps involved in making the hoe, and point out any new techniques which they have not yet seen demonstrated.

Trainer Notes

* Explain that they have already practiced most of the techniques necessary to make the hoe.

* Some of the techniques with which the participants will be experimenting are:

  - cutting the stock to proper size (10"x5")
  - hot cutting indentations for the collar
  - forming the blade of the hoe
  - forming the collar
  - using a drift or mandrel as a tapered fuller
  - swaging and wrapping the collar
  - rounding edges and dressing the blade

* During the discussion, it can be assumed that participants will identify the swaging of the workpieces as a new technique which they have not yet practiced.

Step 4. (10 minutes)
Briefly explain and demonstrate the process of swaging.

Trainer Notes

* For the demonstration, use a workpiece which has been pre-cut and taken to the point of swaging the collar.

* Be sure to point out and explain proper use of swages and fullers and several applications of the processes.

Step 5. (2 hours)
Have the participants form their work teams and make a field hoe up to the point of case hardening.

Trainer Notes

* Circulate among the work teams and provide assistance whenever necessary. Be careful to allow participants the maximum opportunity to work among themselves and creatively seek ways of overcoming difficulties they may be experiencing.

Step 6. (10 minutes)
Reconvene the group and have participants discuss case hardening as a viable alternative to tempering for local blacksmiths.

Trainer Notes

* Ask participants to identify some of the factors which make it difficult for local blacksmiths to temper steel. Mention such factors as the unavailability of temperable steel stock (other than leaf springs) and the time and heat required to draw out leaf springs.

* Explain that their hoes are made of 1/8" mild steel which cannot be tempered. The hoes can, however, be hardened by putting a hard coat or "case" on the outside of the steel. This process is called "case hardening."

* Briefly describe the process of the molecular migration of carbon into steel.

* Ask the participants to describe how case hardening can be a desirable alternative to tempering.

Step 7. (15 minutes)
Demonstrate the proper procedures and techniques for case hardening a field hoe.

Trainer Notes

* Include in the demonstration such techniques as:

  - proper use, mixture, and placement of carburizing agents

  - bringing material to critical temperature

  - construction of the case

* Briefly describe alternative carburizing agents (wood, charcoal, animal bone, leather, etc.) and mention other methods of case hardening.

Step 8. (35 minutes)
Have the participants return to their stations and case harden their hoes.

Trainer Notes

Provide assistance whenever necessary.

Step 9. (10 minutes)
Reconvene the group and have them discuss any technical difficulties which they encountered.

Trainer Notes

Stimulate discussion and a sharing of experiences by asking:

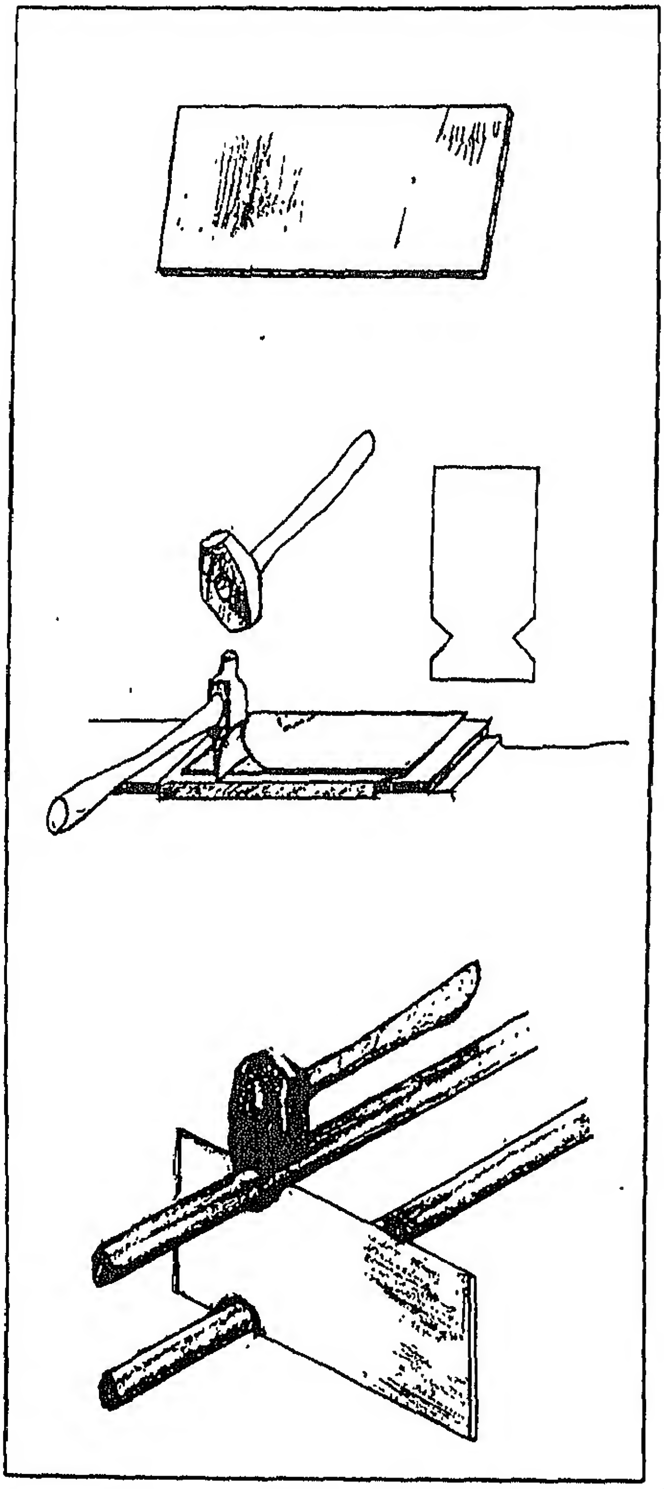
* Which techniques seemed easy to perform? Why?
* Which seemed difficult? Why?

Step 10. (10 minutes)
Conclude by asking participants to discuss the difficulties encountered by a local blacksmith in making agricultural tools.

Trainer Notes

* The following questions can serve as a guide in focusing the discussion:
  - What problems did you encounter in attempting to make the hoe based on the instructions given?
  - How are these difficulties similar to those faced by local blacksmiths when they are asked to make an agricultural tool?
  - What could a blacksmith or his/her assistant do to help reduce these problems?
* Mention that in the next session, participants will be asked to make a cross-peen hammer based on a set of instructions and that they should bear in mind the key points of this discussion during that activity.

AFRICAN FIELD HOE

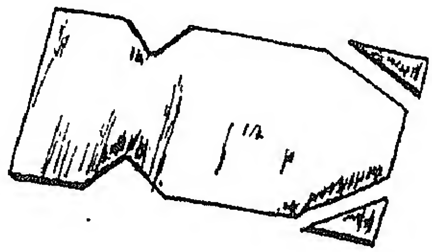


SELECT AND CUT MATERIALS

Lightweight, durable field hoes can be forged from heavy gauge sheet metal. Car bodies, truck panels, and some tank containers (water heaters, propane tanks) are potential sources of this type of metal.

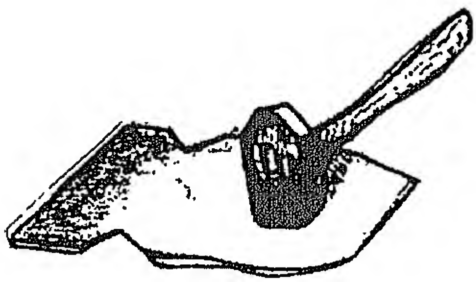
To make an all-purpose field hoe, begin by cutting a piece of 1/16" mild steel (sheet metal or other) into a rectangle 10" x 5". If the metal is not flat, flatten it.

FULLER THE STOCK (optional)



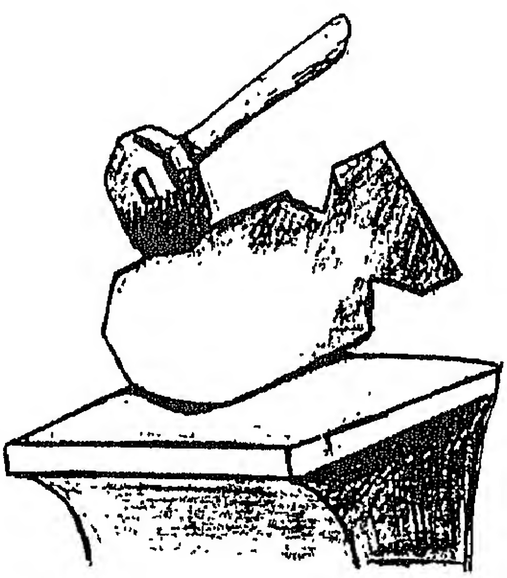
CUT THE BLADE CORNERS

Heat the end of the blade and cut off the corners. This will make it easy to give the blade a rounded nose later (Step 5).



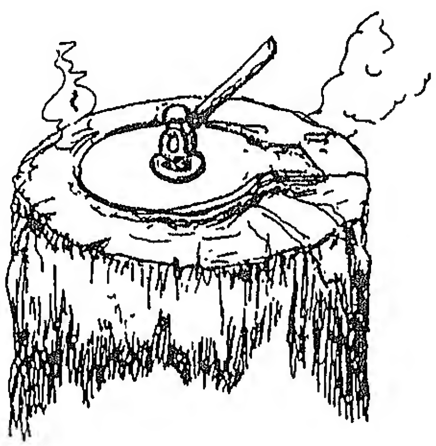
SPREAD THE BLADE, TAPER THE BLADE

Bring the blade to forging heat and begin to draw the nose into a taper. Direct hammer blows so that the metal spreads and forms a curved blade, and the blade thickness graduates from 1/16" to 1/32" from back to front.



ROUND THE BLADE

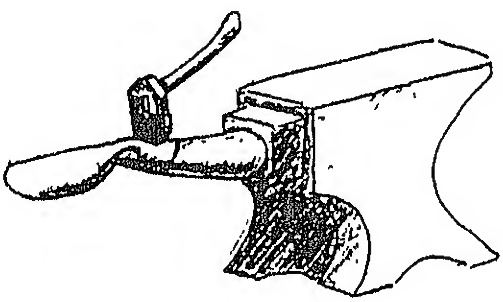
Heat the blade and bring the edge to finished roundness. Hold the blade at right angles to the anvil and hammer the uppermost edge; if the metal has been uniformly heated, both top and bottom edges will be worked with each hammer stroke. (The action of the hammer strike will be equal to a reactive "strike" by the anvil.)



SINK THE BLADE

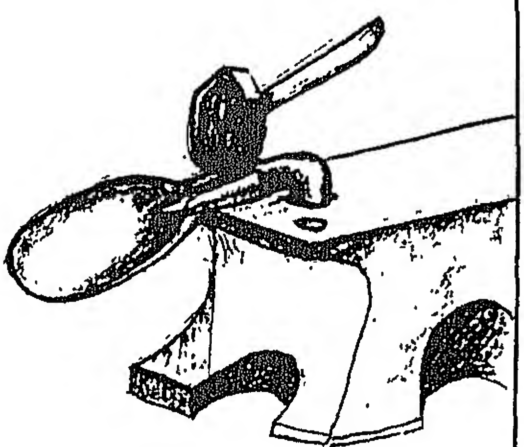
Bring the blade to forging heat and lay it over a mold having the desired curve. Use a wide ball-peen hammer to "sink" the blade into the mold. The mold can be pre-made by pounding a finished blade into hard earth.

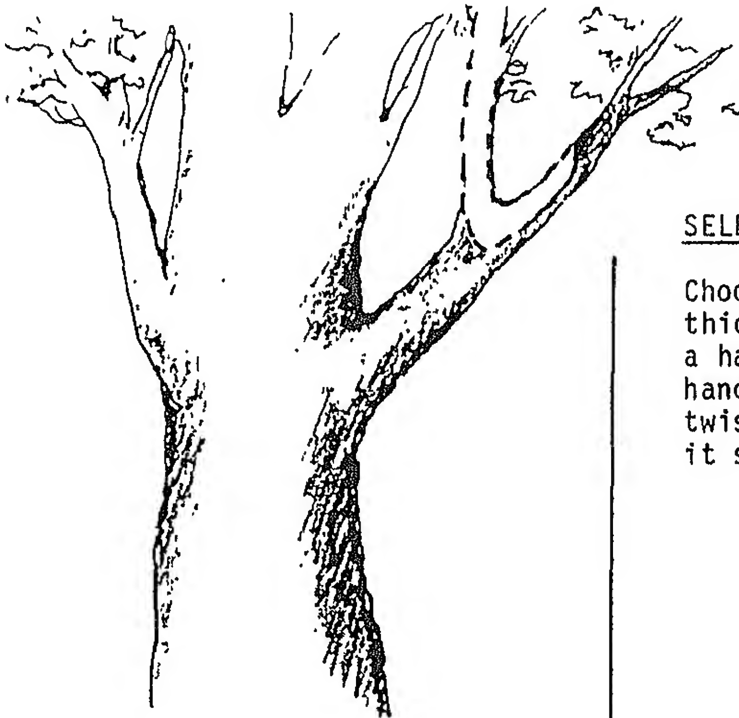
An alternative method for bending the blade is to hammer it over a form (anvil, car bumper, earthen mound, etc.)



FORM THE COLLAR (socket)

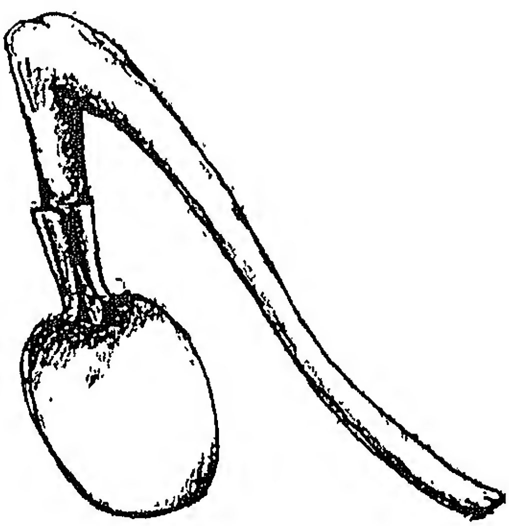
Form the collar by heating the socket material and hammering it around the horn of the anvil (7-A). Finish it by closing it around a bick horn or other tapered object similar to a hoe handle (7-B).





SELECT A HANDLE

Choose a hardwood with the desired thickness and shape and hew it into a handle. Tree forks make excellent handles because they have tight, twisted grain. Taper the shaft so it slides into the collar.



MOUNT THE HANDLE

Place the shaft into the collar. Set it by tapping the heel of the handle on a rock or log.

The blade can be taken off the handle by tapping the shaft against any hard surface.

FORGING A CROSS-PEEN HAMMER

Total Time: 4 hours

Objectives:
* To discuss types of scrap steel suitable for making hammers
* To forge a cross-peen hammer
* To identify and discuss the forging of other types of tools that may be made from a hammer hea blank

Resources:
* Attachment 16-A, "Forging a Cross-Peen Hammer"
* Andrews, pages 78-82

Materials: Examples of scrap steel suitable for hammer-making; e.g., car, truck and rail axles, rail car springs, etc. (see Steps 1 and 2); one section of truck or car axle (half-section between gearbox and wheel) per station; a prototype hammer blank finished to the point of dressing and tempering.

Procedures: Step 1. (5 minutes)
Briefly explain the objectives and draw the group's attention to the display of scrap metal for hammer-making.

Step 2. (10 minutes)
Ask participants to explore the assortment, to ident each item, and to discuss why the scraps are appropr for making hammers.

Trainer Notes

* Have the group refer to the scrap pieces' previous uses and describe the steel grades and properties.
* Ask participants:
  - Have they seen these and other scrap pieces used for hammer making in local forges?
  - If axles are not used in local hammer forging, what type of material is?
  - If hammers are made from material other than axles, are they case-hardened?

Step 3. (15 minutes)
Distribute Attachment 16-A, "Hammer Illustrations" and discuss the procedure of forging a cross-peen hammer. Show an example of a hammer forged from an axle.

Trainer Notes

* Explain to the group that, using the illustrations in the attachment as a guide, they will cut off one end of an axle and forge their hammers to the point of grinding or dressing.

* Stress that, as no step-by-step demonstrations will be given until grinding and tempering, it is essential to carefully study each illustration.

* Have the participants study the pictures one-by-one, and describe the process depicted in each.

* Mention that each step in the process may take several heats to accomplish.

* Briefly demonstrate the striking technique on a piece of scrap axle and have several in the group try it with you.

* Point out any important details which they have missed, and ask for questions and clarifications.

* Encourage the participants to rely as much as possible on the illustrations, their own experience, and the skills and knowledge of others in the group while working through the activity.

Step 4. (2 hours)
Have the participants forge the hammers.

Trainer Notes

* Check in with each team periodically but offer assistance only when necessary.

* Help the groups identify errors or incorrect techniques by referring them to the illustrations and discussion during Step 3.

Step 5. (10 minutes)
When the hammers are forged, demonstrate grinding or dressing techniques using the unfinished prototyp

Trainer Notes

Emphasize that:

* Edges on both peens should be rounded and smooth so that no marks will be left on the work.

* Faces should be as polished as possible.

Step 6. (60 minutes)
Have the teams dress and anneal their hammers.

Step 7. (5 minutes)
Describe the tempering process for the hammers.

Trainer Notes

* Explain that the hammers will continue annealing through lun and early afternoon. By the end of the next session, they will be ready for tempering and time will be provided.

* Also mention that participants may wish to make handles and mount their hammers during free time or open shop.

Step 8. (10 minutes)
When all the groups have finished, facilitate a brief discussion on the experience of learning to forge a hammer using drawings as a guide rather than demonstrations.

Trainer Notes

Stimulate response by posing these questions:

* Did the participants find out most of the vital information before or during the forging activity.

* How were problems resolved? By asking the trainer for help? By observing others in the group? Through trial and error?

* Does the group understand the process and feel comfortable with the skills involved in hammer-making? If not, why not?

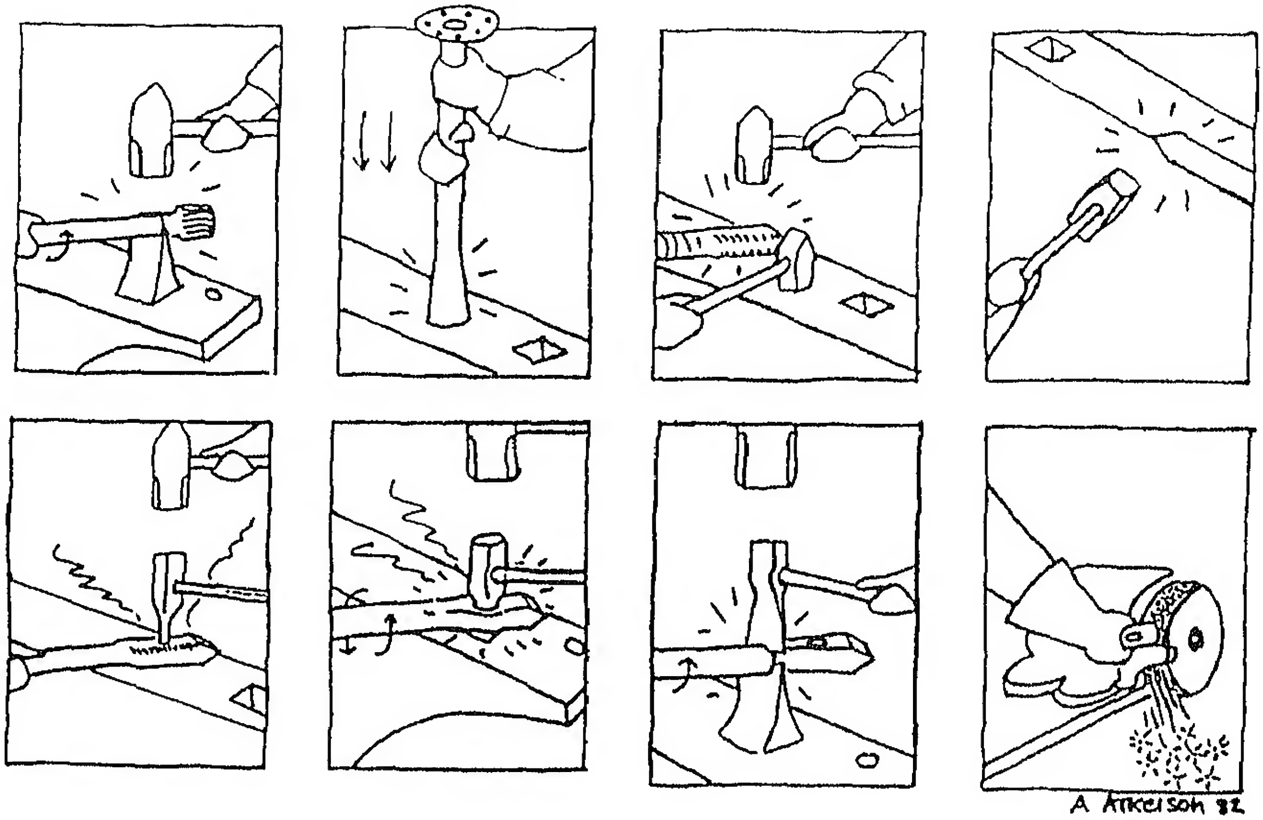
Step 9. (5 minutes)
Ask participants to identify and discuss the formi of other tools which may be made from a hammer bla

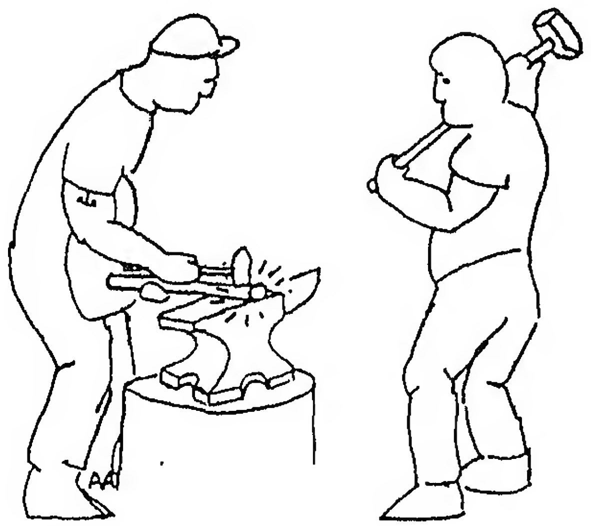
Trainer Notes

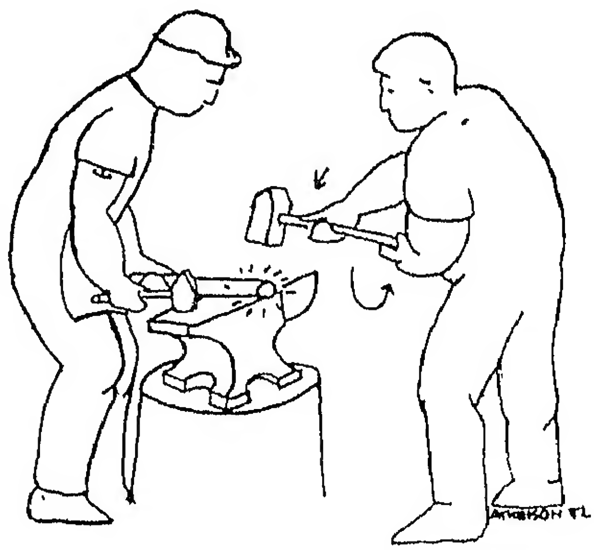
* Have the group scan the tools in the forge area for ideas.

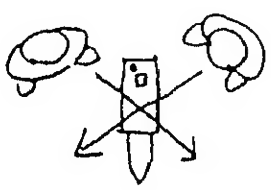
* Ask them to give examples of other tools they have seen used at their worksites which may be formed from the hammer blank.

FORGING A CROSS-PEEN HAMMER









Direction of hammer blows should be at 45^{o} angles to the anvil and away from each other for safety.

FORGING CUTTING TOOLS: THE WRAPPED-HANDLE KNIFE

Total Time: 4 hours

Objectives:

* To practice basic blacksmithing skills involved in making common agricultural cutting tools
* To make a wrapped-handle knife
* To practice working effectively in groups
* To idenfity and use techniques for the disseminat of blacksmithing skills
* To discuss the feasibility of producing agricultu cutting tools in local forges

Resources: Andrews, pages 91-93.

Materials: Newsprint, felt-tip pens, one 3/16" piece of leaf spring steel per participant (10"x1-1/3"), assorted examples of scrap steel suitable for making knives or machetes, one 30" strip of 3/4" innertube per participant, two or three examples of completed, locally-made, wrapped-handle and tang-type knives (and machetes, if possible).

Trainer Notes

Prior to this session, an effort should be made to make or purchase two or three examples of locally-forges knives and machetes (see Step 2).

Procedures: Step 1. (10 minutes)
Explain the session objectives and outline the procedures.

Trainer Notes

* Explain that the techniques involved in making machetes and other chopping or cutting tools are essentially the same as those involved in making a knife. Variations which exist relate primarily to the length of time needed to forge and the complications encountered in tempering a longer cutting edge.

* Point out that the knife to be made during this session will provide participants with practice in the basic skills necessary to experiment further at their work sites with designs of other locally appropriate and acceptable cutting tools.

Step 2. (10 minutes)
Distribute among the group one wrapped-handle knife and one tang-type knife, and ask participants to examine them carefully.

Trainer Notes

If examples of machetes are available, distribute them also.

Step 3. (15 minutes)
Have the participants identify and discuss the procedures and techniques involved in making the knives.

Trainer Notes

Some points which should be mentioned include:

- making a template
- type of steel used
- shape of the tang
- proper heating of steel
- forming the tang
- cutting the materials
- forming the blade
- annealing the blade
- tempering (oil vs. water)
- sharpening
- grinding

* As participants correctly identify the procedures involved, list them on posted newsprint.

* Provide assistance by adding and explaining any new procedures or variations of old techniques which may be involved.

Step 4. (10 minutes)
When the list is complete, ask participants to identify those procedures or techniques which they would like to see demonstrated.

Trainer Notes

Refer to the posted list and circle their responses.

Step 5. (10 minutes)
Introduce and explain the guidelines for the knife-making activity.

Trainer Notes

* Explain that the teams should work among themselves with minimal dependence on the trainer.

* Point out that the making of the knife involves using many of the basic skills practiced earlier in the training, and will also serve as an opportunity:

Continued

Trainer Notes/Continued

- to practice working effectively in groups

- to use techniques involved in sharing blacksmithing skills with others, and

- to simulate the condition of working at their sites with local blacksmiths.

* Remind participants of the importance of using the posted lis of procedures as a guide while they are working.

Step 6. (2 hours, 15 minutes)
Have the participants form their work teams and make wrapped-handle knives.

Trainer Notes

* Throughout the activity, encourage teams to seek advice and solutions from their fellow participants as an alternative to relying on trainer interventions.

* Observe carefully and offer assistance as teams approach those procedures and techniques which were identified as needing demonstration.

* If some of the teams do not complete their knives in the time allotted, explain that time will be provided for the completion of unfinished projects on Day 6.

Step 7. (10 minutes)
When the group finishes, ask participants to discuss the feasibility of producing knives, machetes, and other similar cutting tools in local forges.

Trainer Notes

* Stimulate discussion by asking:

  - What locally available materials would be most suitable for making quality cutting tools?

  - What are the procedural differences between making a knife and making a machete?

  - How long would it take a skilled blacksmith to make a quality machete? Knife?

  - How much would the blacksmith have to charge for the tool?

  - How does this compare with factory made models?

Step 8. (40 minutes)
Have participants return to the hammers which they forged during the morning activity and perform the tempering process.

SESSION 10: HYDRAM CONSTRUCTION - CONCRETE Time: 18 hours over a 7 day period

OBJECTIVES:

- to design and build a concrete ram
- to demonstrate a knowledge of ram component relationships;
- to work with concrete and forms.

OVERVIEW: The session provides participants with an opportunity to use the knowledge gained earlier in the training program to assess site potential, determine an appropriate hydram size and design and then construct an inexpensive, long lasting concrete hydram. While building a concrete hydram necessitates scheduling a lengthy session over at least seven days, the advantages of this technology (i.e., low cost, excellent longevity, likely availability of materials) make this one of the most useful parts of a hydram training program.

PREPARATION NOTES FOR TRAINER: When possible, the concrete hydram(s) should be built at a site where it can be of use after the training program is over. Trainers should therefore gather data about community need, end-uses etc. unless extensive time is available for trainees to do this.

The timing of the various construction phases will be somewhat dependent on the mixture of the concrete and the ambient temperature. In general, the building of a concrete hydram will require four segments of time with a minimum of 2 days between segments. The first phase requires approximately 4 hours for steps 1-9 (planning) and 4 hours for steps 10-19 (base form construction and the first pour). The second phase should occur at least 48 hours later and should take about 4 hours for steps 20-27 (accumulator form construction and 2nd pour). After another 48 hours or so, the concrete should be sufficiently set up for steps 28-35 (fabrication and attachment of valves, bolting the hydram together). In general, the hydram should be ready for steps 36-38 (installation and operation) after 2 more days, or four days from the last pour.

Trainer should check porosity of concrete prior to this activity.

Hand outs B-F are in metric and English units.

Use of slides greatly enhances concrete construction preparation session.

MATERIALS: gravel, sand, cement, water, form lumber, plastic pipe, bowl, fittings, material for vapor barrier something to mix cement in.
Size and quantity of materials is dependent upon the hydram to be constructed. Following is an example of a typical list of materials for a 1" hydram.

1" CONCRETE HYDRAM MATERIALS LIST

1 1"x 12"x 8' lumber for body form	8 3/8 althread 36"
1 1"x 12"x 8' lumber for accumulator forms	26 3/8 lock washers
1 ¼"x 7" diameter steel plate	26 3/8 flat washers
1 3" PVC pipe cap	26 3/8 nuts
1 4" bowl	1 1" pipe plug
1 1'x 1'x ½ belting	1 1" pipe tee
1 7" diameter x ½" belting	1 ½" pipe plug
1 1"x 2" angle 1" long	1 ½" pipe tee
1 rubber stop bumper	1 ¼" pipe plug
1 ¼" gas cock	1 ¼" pipe tee
1 1" PVC pipe 2' long	2pcs. ¼" pipe 2" long
1 ½" nipple 1½" long	1 1" PVC male adaptor
2 2½" washer with 3/8" hole	1 ½" PVC pipe 22' long
2 1½" washer with 3/8" hole	1 1" PVC coupling
5/16" wing nut	½ lb 6d nails
1 5/16 x 2½" bolt	form oil
2 ¼ x½ bolt	2½ gal water
3 5/16 nut	32# cement
1 3/8 bolt 1" long	1 1/3 cu.ft. gravel
1 3" PVC pipe 18" long	1 1/6 cu.ft. sand
Handouts 10A-10N	shovels

PROCEDURES

Phase I: Part One

1. State the objective of this session.

2. Have the trainees gather all pertinent information concerning the hydram installation including drive head, delivery head, flow rate at source, demand, future needs, and potability.

3. Describe the concrete hydram concept and the design parameters involved.

4. Review the advantages and disadvantages of this design.

5. Walk through design steps, using handouts 10A - I. Write on board/ flipchart as developed.

   Trainer should plan how to display this on chalkboard.

   Sequence:

   A. Concrete: (handout 10A)

      1. Compute D.
      2. Compute impulse valve cavity diameter.
      3. Compute wall thickness.
      4. Top and bottom thickness.

   B. Size Impulse Valve Opening (2D)

      Remind trainees that this is related to drive head, force.

      1. Use attachment 10B to determine thickness of valve plate.
      2. Use 10A to determine bolt area and number of bolts.
      3. Use 10C to determine backing thickness.
      4. Use 10D to determine seat width.

   C. Size check valve

      Relate this to drive pipe size as basis for calculations.

      1. Use 10E for backing thickness.
      2. Use 10F to determine seat width.

PROCEDURES

6. Have the trainees each design a hydram, using the design paramenters listed in Handouts A through I. Have the participants solve the problem in attachment/handout 10M.

7. Compare designs and discuss the differences.

8. Depending on how many hydrams are to be made, the trainees should choose the best design(s) and explain why they have made their choice.

9. Give an overview of construction process and scheduling in the workshop:

   Phase I:

   A. Build forms, using pipes, cups, form lumber, as in Handout 11H-J.
   B. Note where/why sleeves are inserted; where # comes from.
   C. Make sure snifter is included.
   D. Mix and pour concrete.
   E. Protect and let it set up for at least 2 days.
   F. Draw pattern for impulse valve plate.

   Phase II:

   A. Construction of accumulator form.
   B. Pour accumulator.
   C. Let it set up.

   Phase III-IV:

   A. Cut check valve, assemble and install.

10. Distribute procedures for Phase I. Ask trainees to read through. Clarify any questions.

11. Have the trainees make up a material and tool list for the hydram(s) selected.

NOTES

This may be hard for trainees to visualize. A model would be helpful; slides are also effective, and may be procured through the Energy Sector, Peace Corps.

PROCEDURES | NOTES

12. With all the tools and materials gathered, begin construction.

Phase I - Part Two

13. Start by constructing the hydram base form. (See handout 10J)

14. Next, bend the PVC pipe and cut to proper length and angles. Be sure to glue a coupling to the check valve end to increase the seat area.

15. Notch out bottom of plastic bowl to fit upon the PVC pipe: with the bowl and pipe held together, mark where the pipe touches the inside of the bowl; then, using coping saw, cut along this line. Attach male adapter and the plugged tee to input end of pipe. The plugged tee serves to prevent the pipe from turning within the concrete. Welding a piece of metal onto the coupling would also work.

16. Drill holes in the bottom of the form for the bolt pattern around the impulse valve and the accumulator.

17. Center accumulator form pipe on the inside of the form and draw a circle around it. Drive three 6d nails one-half way in, 120 degrees apart through the circle, making compensation for the thickness of the accumulator form pipe.

18. Drill hole in PVC pipe for snifter. Drill another hole in form for the other end of snifter. Snifter pipe should have a plugged tee in the middle or a piece of metal welded to the side of it to eliminate turning.

19. An elliptical rubber washer should be cut out and nailed where the check valve end of the PVC pipe comes in contact with the form. This is to recess the concrete around the check valve seat to insure a good seat.

PROCEDURES | NOTES

20. Bolt sleeves to form using althread, nuts and washers.

21. Tie PVC pie down to form using tie-wire.

22. Pour the base of the hydram using the following concrete formula: 8 parts gravel, 7 parts sand, 2 parts cement, and water to proper consistency. Tap on the form sides while pouring to prevent air pockets. Cover concrete with a vapor barrier such as visqueen, then cover entire pour with insulation. Draw pattern for impulse valve plate and send to metal shop.

Phase II

23. After the hydram base has had sufficient time to set (usually about 2 days), remove form and place hydram base right side up on blocks so that the bolt holes on the bottom can be reached.

24. Place a sheet of plastic or wax paper or anything that will prevent a concrete marriage and that won't wrinkle on top of the accumulator end of the hydram.

25. Place althread and sleeves through bolt pattern at accumulator with nuts and washers on both ends. Tighten until sleeves are rigid.

26. Build form for accumulator as shown in Handout 10J.

27. Place accumulator form pipe over the three nails sticking up through the concrete at the check valve. Pack with sand to prevent pipe from floating up in concrete. Cap end of accumulator form pipe with tape or PVC cap.

PROCEDURES

NOTES

28. Place accumulator form on top of hydram base and install the delivery pipe connection between this form and the accumulator form pipe.

29. Pour accumulator form full of concrete using the same mixture ratio as used in step #22.

30. Cover with a vapor barrier such as visqueen and insulation.

Phase III

31. After concrete has had sufficient time to set up (about one to two days), remove form.

32. Using a large piece of paper, make a pattern from the hydram base for both the impulse valve rubber and the accumulator check valve rubber.

33. Cut out the rubbers according to the pattern. If the rubber is too thick to allow free movement of the valves, a v-notch may need to be cut into the rubber at the flex point of the valve.

34. Drill and cut out a piece of sheet metal for the impulse plate and attach stop bracket.

35. Install althread, bolt, nuts and washers on both pieces of rubber as shown in the attachment.

36. Bolt accumulator to base with check valve rubber for a gasket.

37. Bolt impulse valve rubber and plate to hydram base.

38. Install stroke adjustment bolt locknut and rubber bumper.

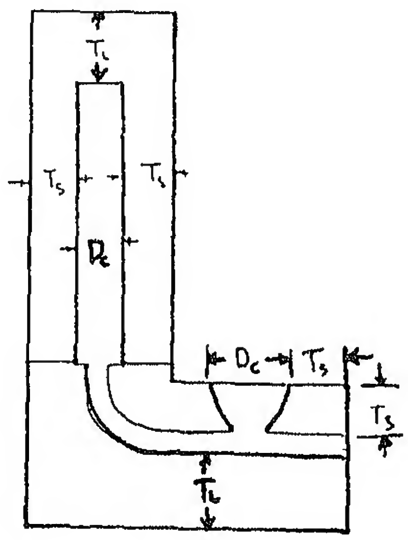
PROCEDURES	NOTES
Phase IV	
39. Install ram to drive pipe and delivery pipe. Start up. Adjust for amount of flow available.	
40. Have the trainees determine the flow rate into and out of the hydram and determine the efficiency.	
41. Discuss with the trainees what they feel the advantages and disadvantages of this ram might be and when they might be important.	

CONCRETE HYDRAM DESIGN PARAMETERS

CAVITY WALL THICKNESS DOME COVER THICKNESS NUMBER OF BOLTS AND SIZE

The side wall thickness (T_S) in a concrete Hydram without reinforcement shall be equal to the diameter of the cavity (D_C) in inches times the drive head (H) in feet divided by 10 or shall be equal to the cavity diameter, whichever is greater.

The top or bottom wall thickness (T_L) should be 1.25 times the cavity diameter.



The total bolt area (TBA) should equal the drive pipe diameter (inches) squared times the drive head in feet divided by 50 or TBA = $\frac{D^2H}{50}$

If D in mm. and H in meters then TBA = $\frac{D^2H}{9677.4}$

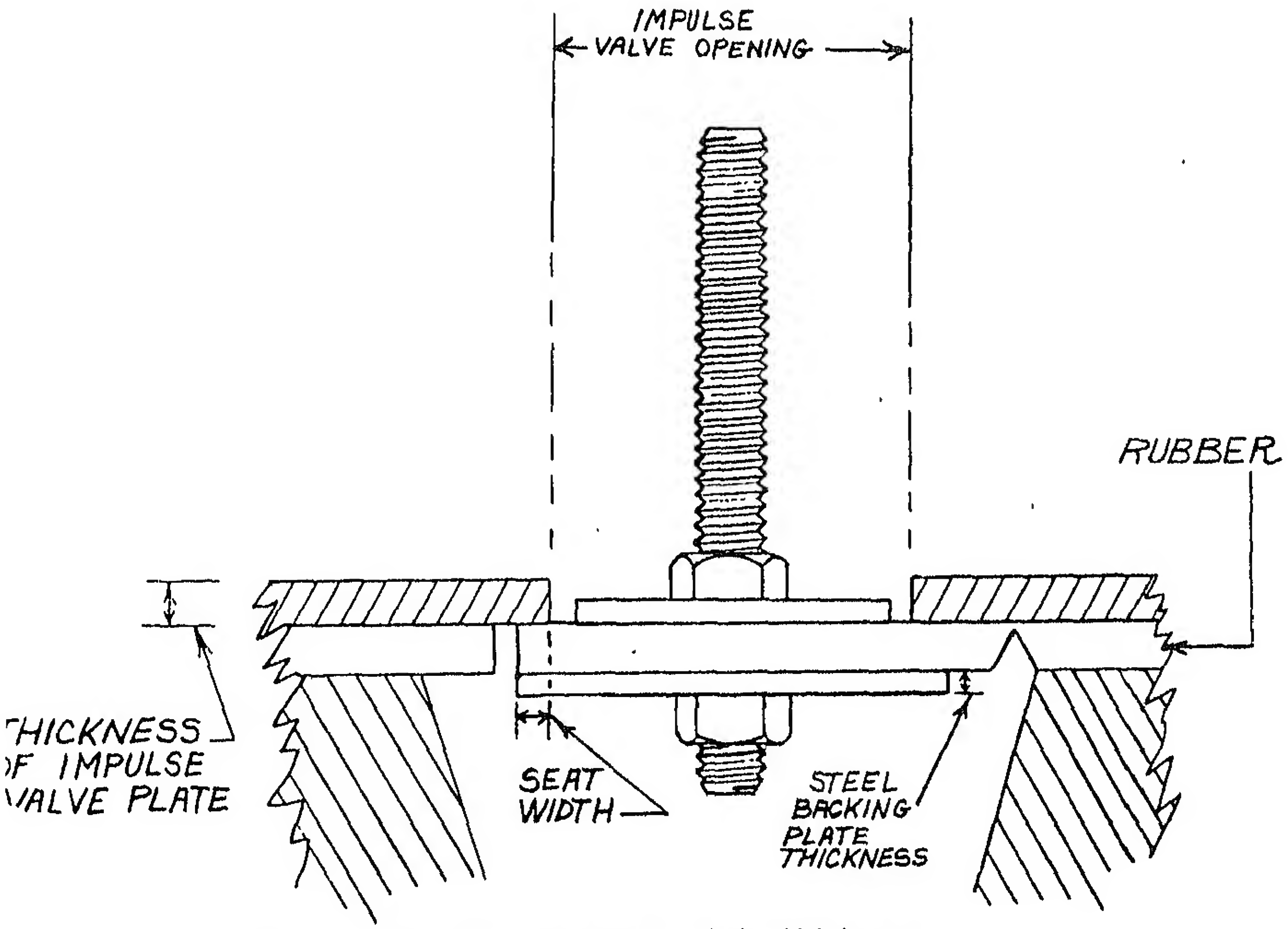
To determine the proper number of bolts, find the area of the bolt size you wish to use and divide it into the total bolt area.

Diameter of bolt:

mm.	6.3	8	9.5	11	12.7	14.2	15.8	19.	22.2	25.4
in.	1/4	5/16	3/8	7/16	1/2	9/16	5/8	3/4	7/8	1
Area of bolt:	.027	.045	.068	.093	.126	.162	.202	.302	.419	.551

THICKNESS OF THE IMPULSE VALVE PLATE IN INCHES *

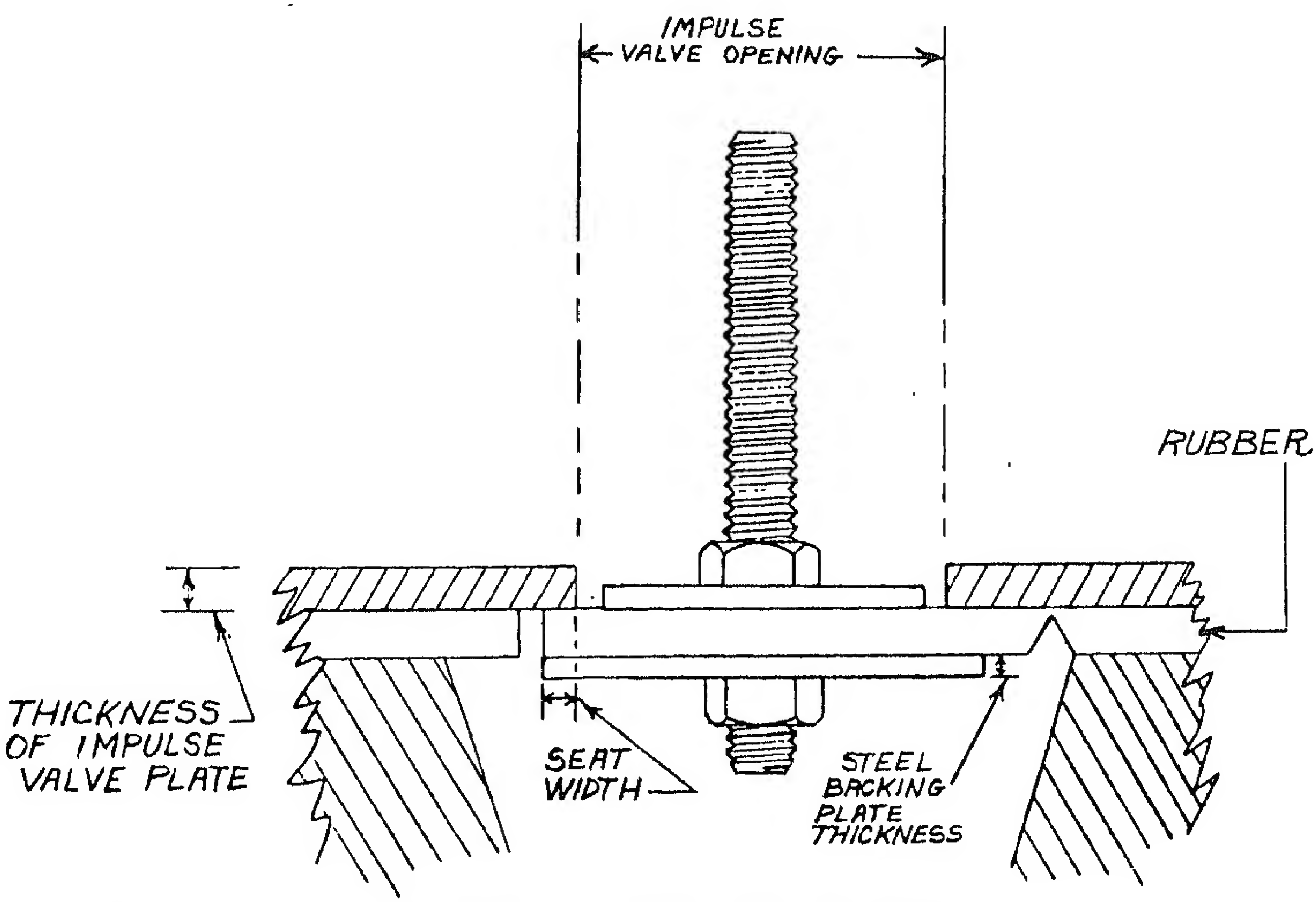
IMPULSE VALVE OPENING IN INCHES	DRIVE HEAD IN FEET 10	20	30	40	50
1.5	1/4	3/8	7/16	1/2	5/8
2	1/4	3/8	7/16	1/2	5/8
2.5	5/16	3/8	1/2	9/16	5/8
3	5/16	7/16	1/2	9/16	5/8
4	5/16	7/16	1/2	9/16	5/8
5	3/8	1/2	9/16	5/8	11/16
6	3/8	1/2	9/16	5/8	11/16
8	7/16	1/2	5/8	11/16	3/4
12	1/2	5/8	11/16	3/4	13/16
16	1/2	5/8	3/4	13/16	7/8



* These figures also apply to accumulator plate thickness.

THICKNESS OF THE IMPULSE VALVE PLATE IN MILLIMETERS*

IMPULSE VALVE OPENING IN MILLIMETERS	DRIVE HEAD IN METERS 3	6	9	12	15
40	6	10	11	13	16
50	6	10	11	13	16
60	8	10	13	14	16
75	8	11	13	14	16
100	8	11	13	14	16
125	9.5	13	14	16	18
150	10	13	14	16	18
200	11	13	16	18	19
300	13	16	18	19	21
400	13	16	19	21	22

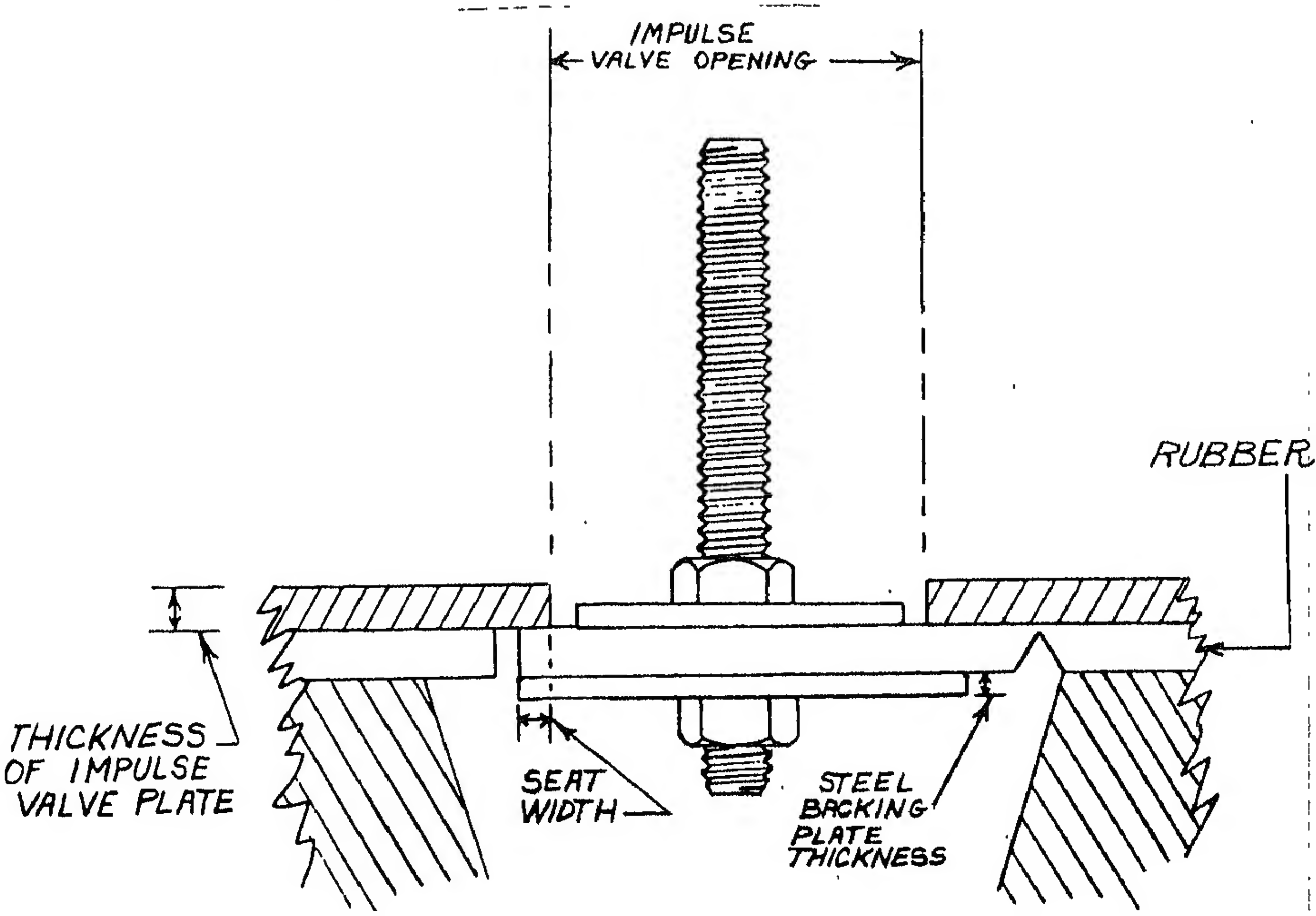


* These figures also apply to accumulator plate thickness.

IMPULSE VALVE STEEL BACKING

DRIVE HEAD IN FEET

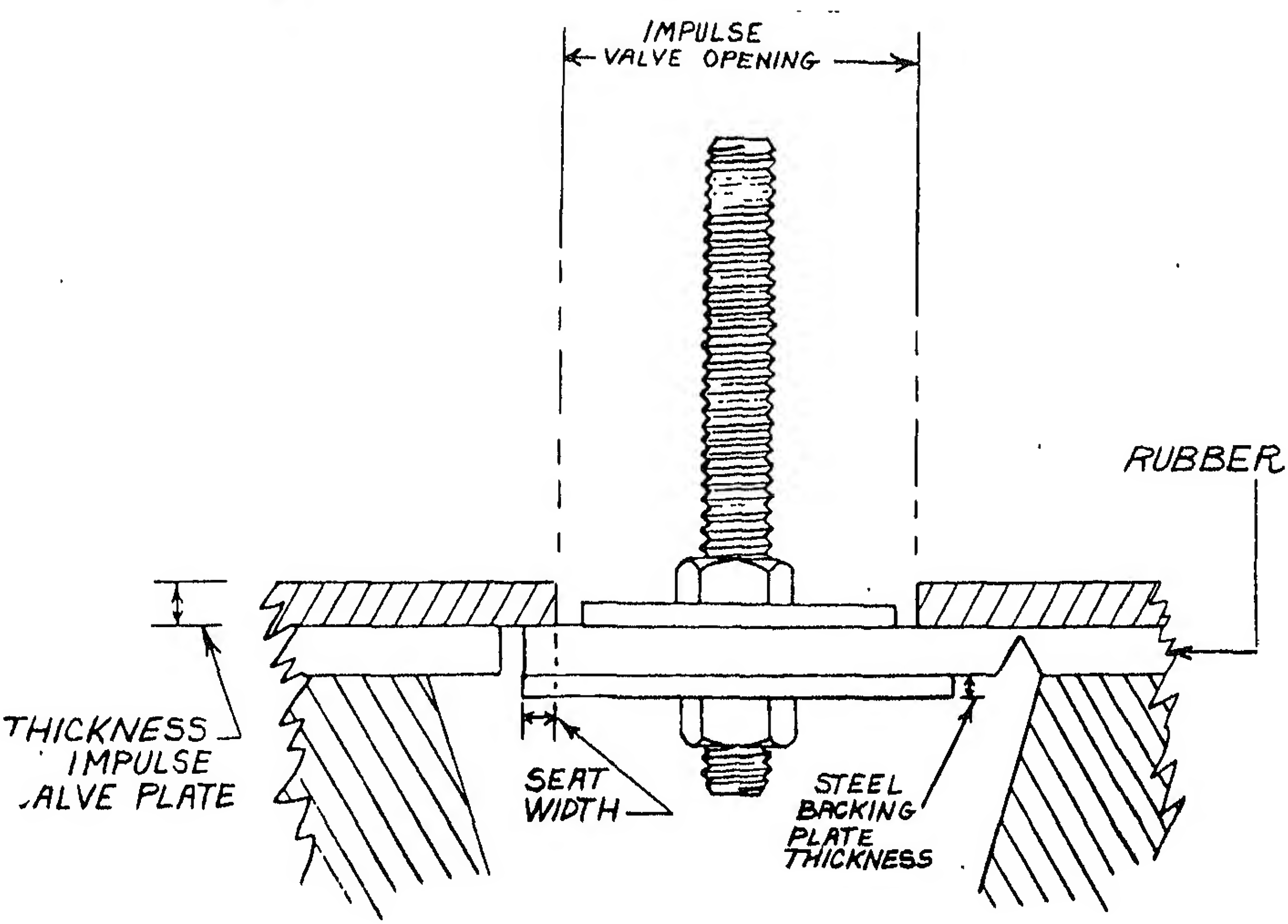
IMPULSE VALVE OPENING IN INCHES	10	20	30	40	50
1.5	1/8	1/8	1/8	3/16	3/16
2	1/8	3/16	3/16	3/16	1/4
2.5	3/16	3/16	1/4	1/4	1/4
3	3/16	1/4	5/16	5/16	5/16
4	1/4	5/16	3/8	7/16	7/16
5	5/16	7/16	1/2	1/2	9/16
6	3/8	1/2	9/16	5/8	11/16
8	1/2	11/16	3/4	13/16	7/8
12	13/16	1	1 1/8	1 1/4	1 5/16
16	1 1/16	1 5/16	1 1/2	1 11/16	1 13/16



IMPULSE VALVE STEEL BACKING

DRIVE HEAD IN METERS

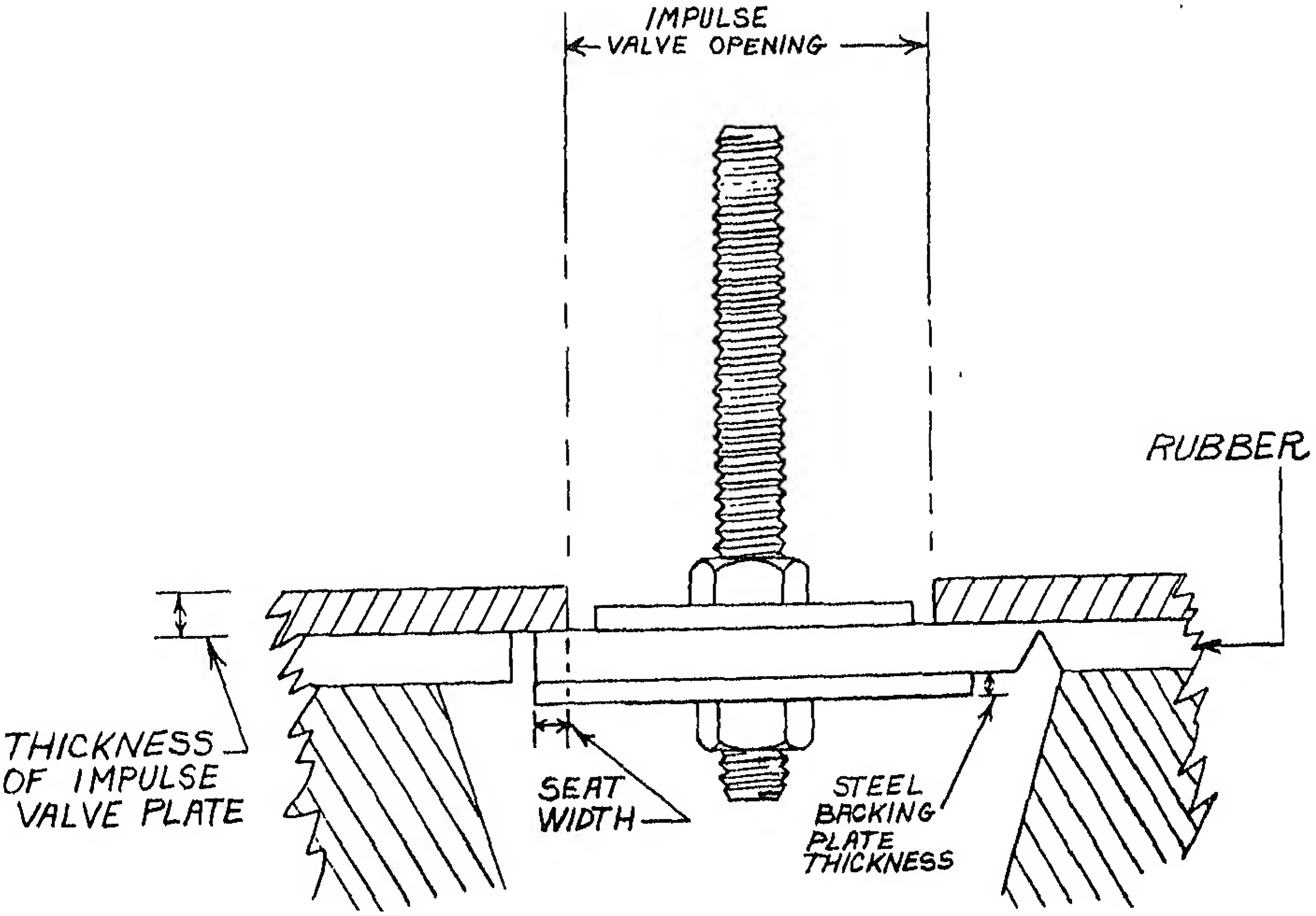
IMPULSE VALVE OPENING IN MILLIMETERS	3	6	9	12	15
40	3	3	3	5	5
50	3	5	5	5	6
60	5	5	6	6	6
75	5	6	8	8	8
100	6	8	10	11	11
125	8	11	13	13	14
150	10	13	14	16	18
200	13	18	19	21	22
300	21	25	29	32	34
400	27	33	38	43	46



IMPULSE VALVE SEAT WIDTH IN INCHES

DRIVE HEAD IN FEET

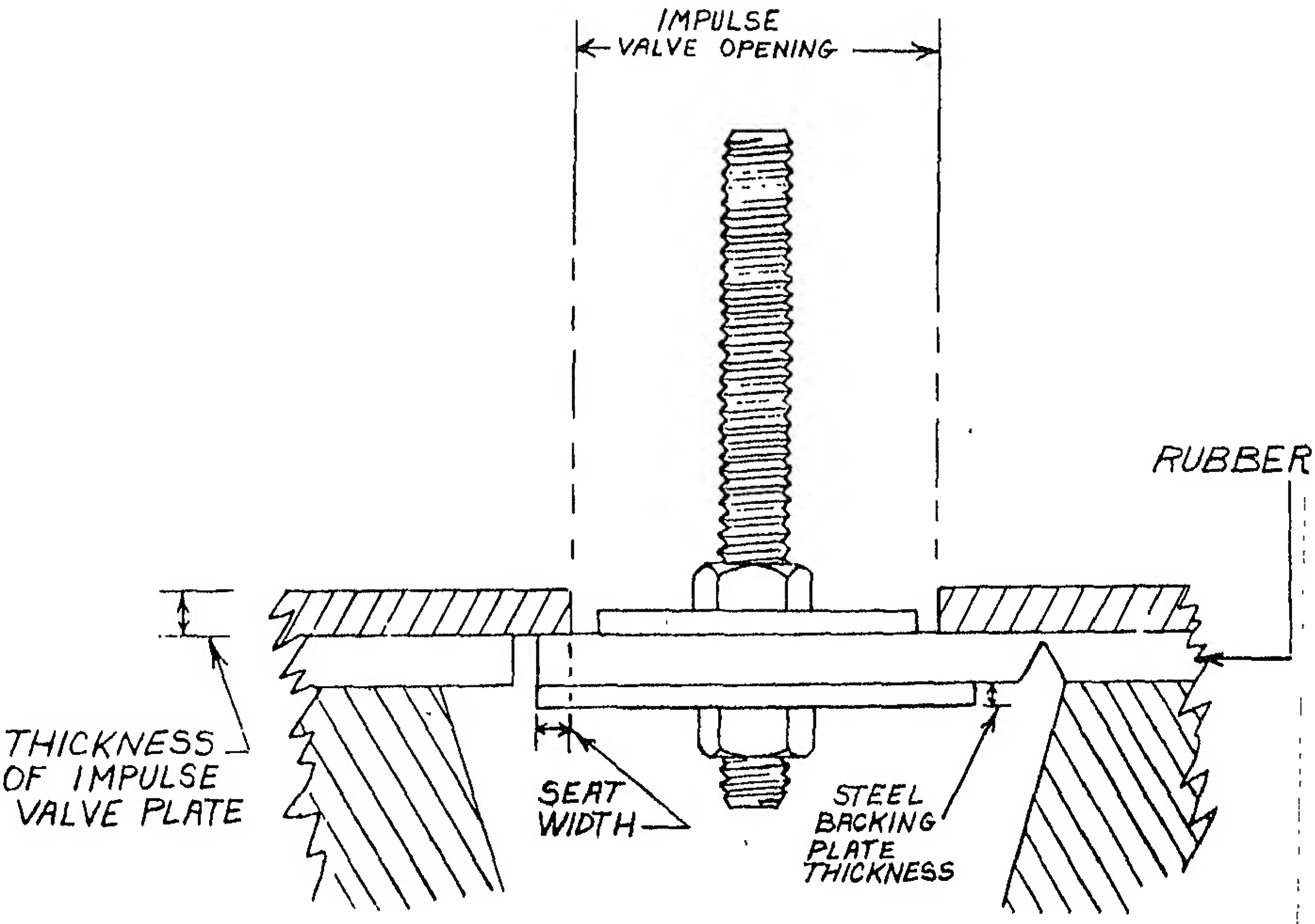
DRIVE PIPE DIAMETER IN INCHES	10	15	20	25	30	35	40	45	50
3/4	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	3/8
1	3/16	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4
1¼	1/4	3/8	7/16	9/16	5/8	3/4	13/16	14/16	1
1½	5/16	7/16	9/16	11/16	3/4	7/8	1	1 1/16	1 3/16
2	3/8	9/16	3/4	7/8	1	1 3/16	1 5/16	1 7/16	1 9/16
2½	1/2	11/16	15/16	1 1/8	1 5/16	1 7/16	1 5/8	1 13/16	1 15/16
3	5/8	7/8	1 1/8	1 5/16	1 9/16	1 3/4	1 15/16	2 3/16	2 5/16
4	13/16	1 1/8	1 7/16	1 3/4	2 1/16	2 3/8	2 5/8	2 7/8	3 1/8
6	1 3/16	1 11/16	2 3/16	2 5/8	3 1/8	3 1/2	3 15/16	4 5/16	4 11/16
8	1 11/16	2 1/4	2 15/16	3 9/16	4 1/8	4 11/16	5 1/4	5 3/4	6 1/4



IMPULSE VALVE SEAT WIDTH IN MILLIMETERS

DRIVE HEAD IN METERS

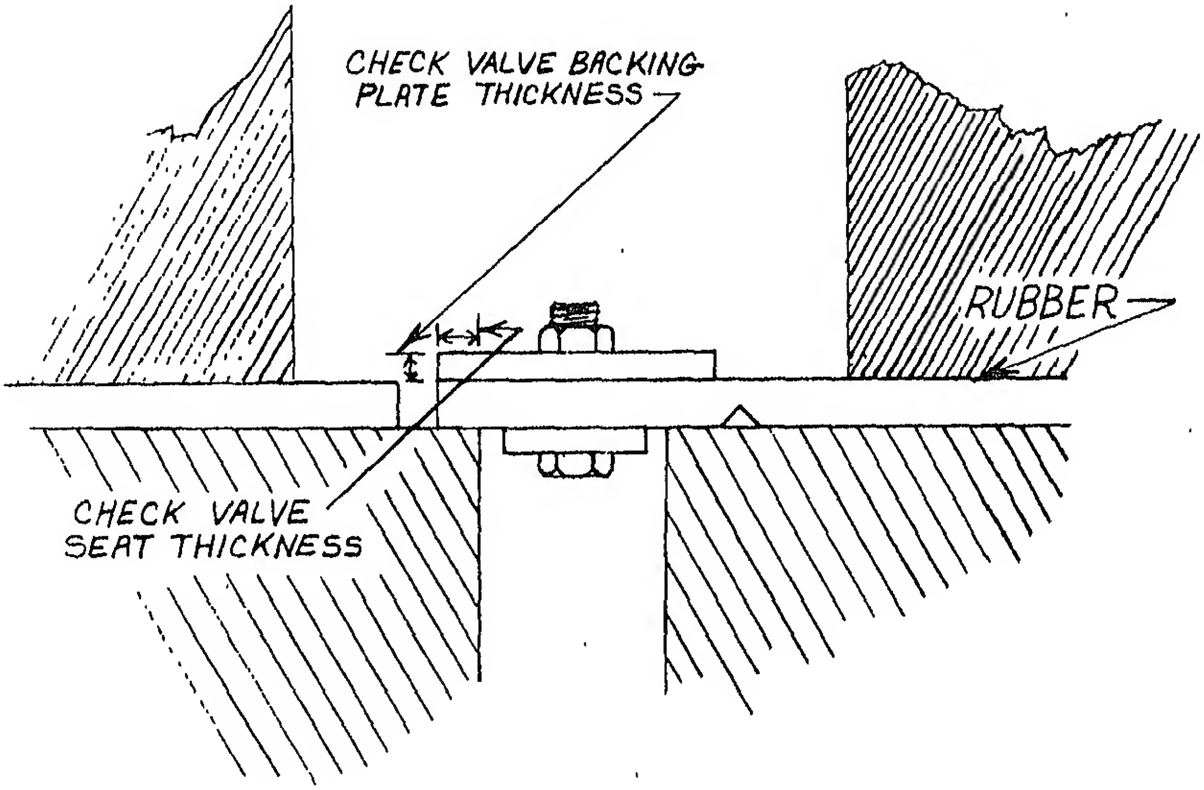
DRIVE PIPE DIAMETER IN MILLIMETERS	3	4.5	6	7.5	9	10.5	12	13.5	15
20	3	5	6	8	10	11	13	14	16
25	5	8	10	11	13	14	16	18	19
30	6	10	11	14	16	19	21	22	25
40	8	11	14	18	19	22	25	27	30
50	10	14	19	22	25	30	33	36	39
60	13	18	24	29	33	36	41	46	49
75	16	22	29	33	39	44	49	55	58
100	21	29	36	44	52	60	66	72	79
150	30	43	55	66	79	89	100	109	119
200	43	56	74	89	104	119	130	146	158



CHECK VALVE BACKING THICKNESS IN INCHES

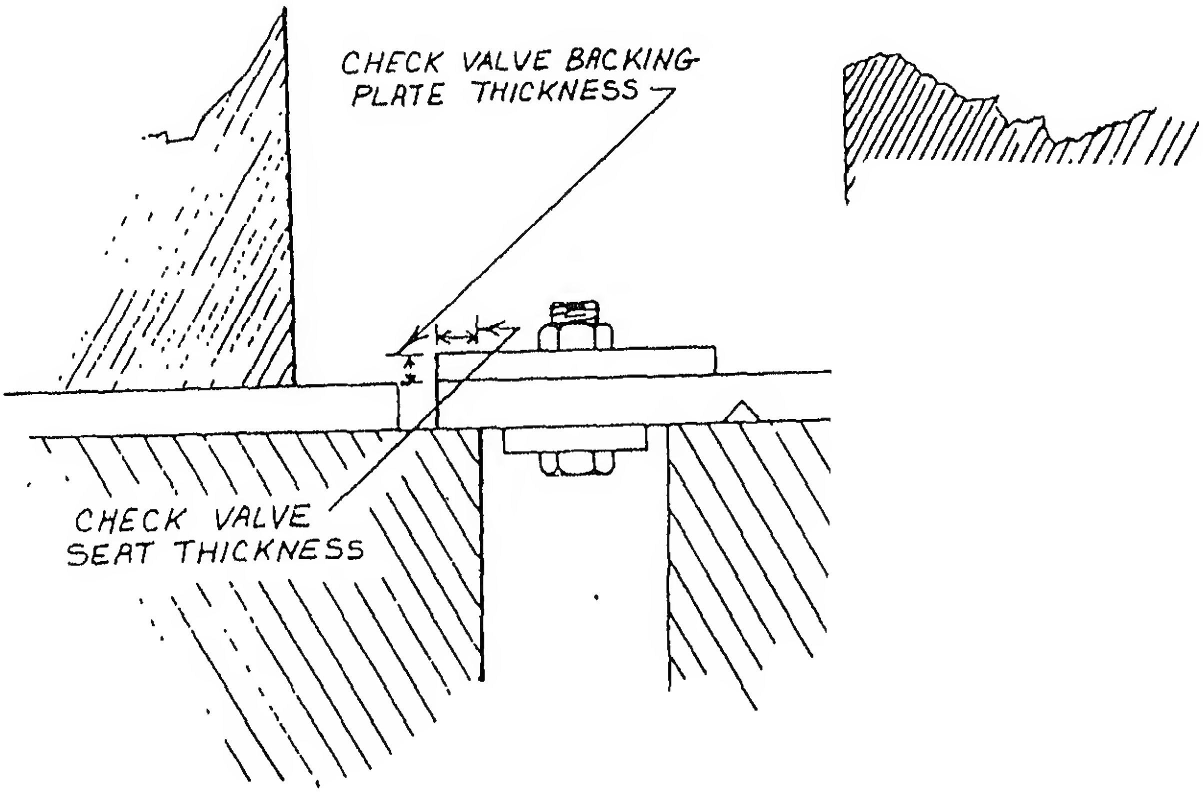
DELIVERY HEAD IN FEET

DRIVE PIPE SIZE IN INCHES	25	50	75	100	125	150	175	200
3/4	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16
1	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16
1¼	1/16	1/16	1/16	1/16	1/16	1/16	1/16	1/16
1½	1/16	1/16	1/16	1/16	1/16	1/8	1/8	1/8
2	1/16	1/8	1/8	1/8	1/8	1/8	1/8	1/8
2½	1/8	1/8	1/8	1/8	3/16	3/16	3/16	3/16
3	1/8	1/8	3/16	3/16	3/16	3/16	3/16	1/4
4	3/16	3/16	1/4	1/4	1/4	5/16	5/16	5/16
6	1/4	5/16	3/8	7/16	7/16	1/2	1/2	1/2
8	3/8	1/2	9/16	5/8	5/8	11/16	11/16	3/4



CHECK VALVE BACKING THICKNESS IN MILLIMETERS

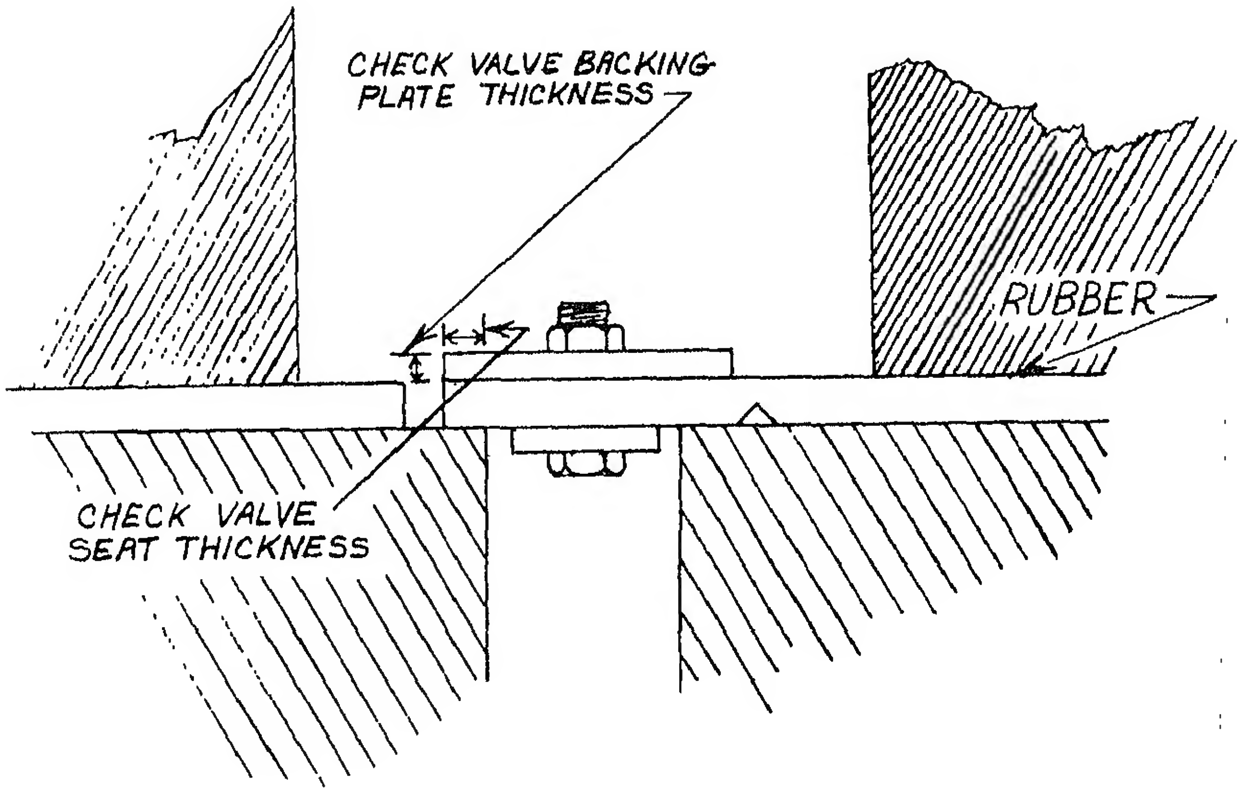
DRIVE PIPE SIZE IN MILLIMETERS	DELIVERY HEAD IN METERS 7.5	15	23	30.5	38	45.5	53.5	60
20	2	2	2	2	2	2	2	2
25	2	2	2	2	2	2	2	2
30	2	2	2	2	2	2	2	2
40	2	2	2	2	2	3	3	3
50	2	3	3	3	3	3	3	3
60	3	3	3	3	5	5	5	5
75	3	3	5	5	5	5	5	6
100	5	5	6	6	6	8	8	8
150	6	8	10	11	11	13	13	13
200	10	13	14	16	16	18	18	19



CHECK VALVE SEAT WIDTH IN INCHES

DELIVERY HEAD IN FEET

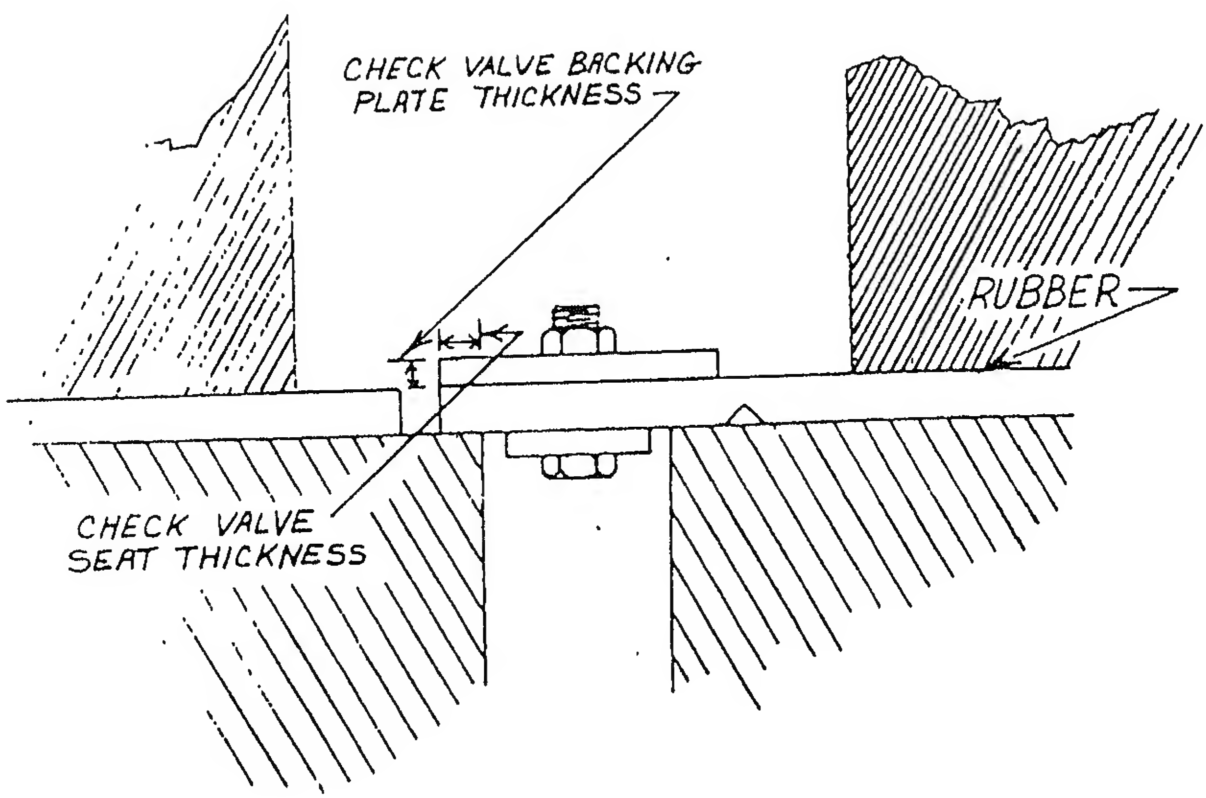
DRIVE PIPE DIAMETER IN INCHES	25	50	75	100	125	150	175	200
3/4	1/8	1/8	1/8	1/8	1/8	1/8	3/16	3/16
1	1/8	1/8	1/8	1/8	1/8	3/16	1/4	1/4
1¼	1/8	1/8	1/8	1/8	3/16	3/16	1/4	3/8
1½	1/8	1/8	1/8	1/8	3/16	1/4	5/16	7/16
2	1/8	1/8	1/8	3/16	1/4	5/16	7/16	9/16
2½	1/8	1/8	3/16	1/4	5/16	7/16	9/16	11/16
3	1/8	1/8	3/16	5/16	3/8	1/2	5/8	13/16
4	1/8	3/16	1/4	3/8	1/2	11/16	7/8	17/16
6	1/8	1/4	3/8	9/16	3/4	1	1 1/4	1 5/8
8	3/16	5/16	9/16	3/4	1	1 5/16	1 11/16	2 3/16

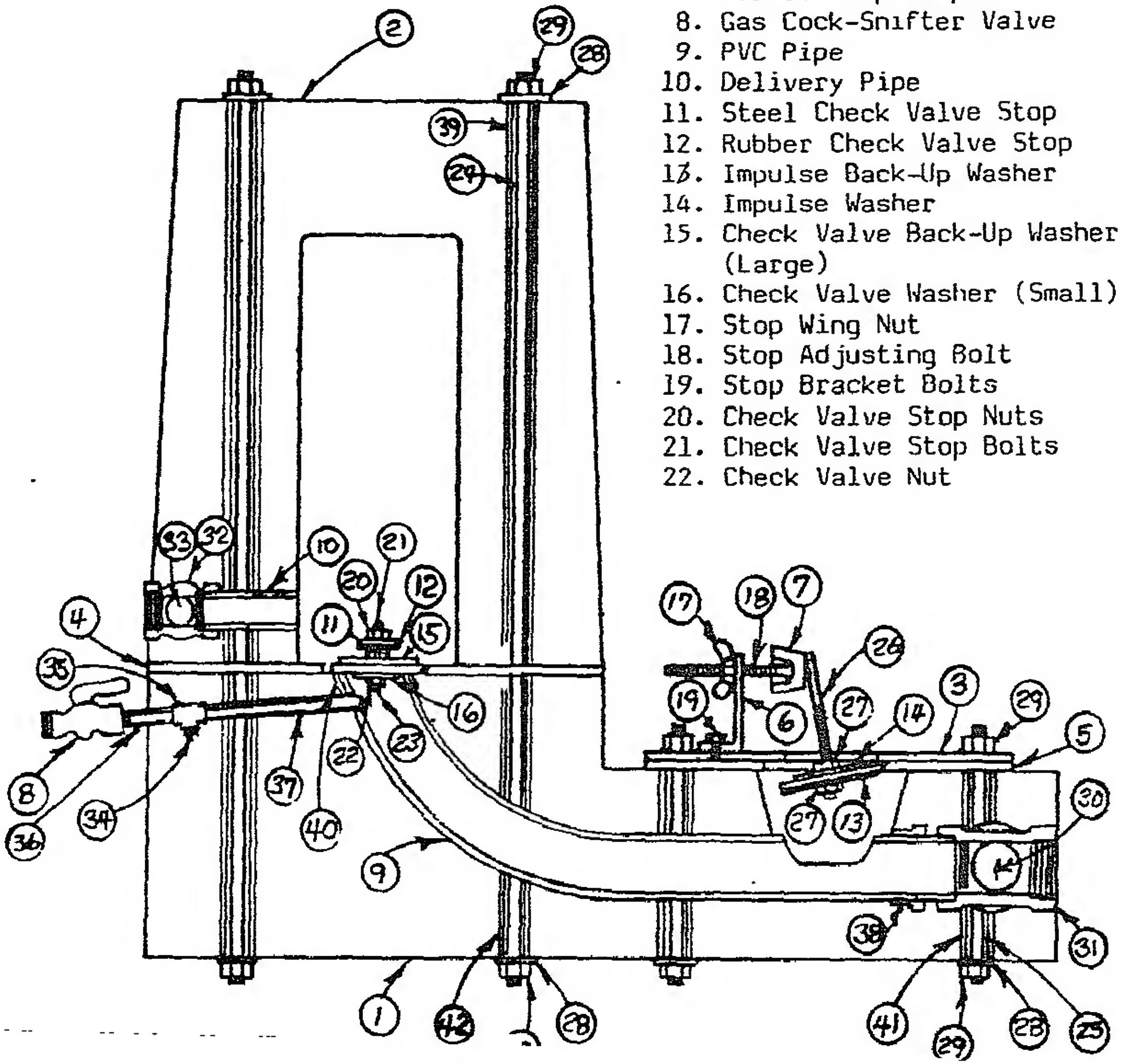


CHECK VALVE SEAT WIDTH IN MILLIMETERS

DELIVERY HEAD IN METERS

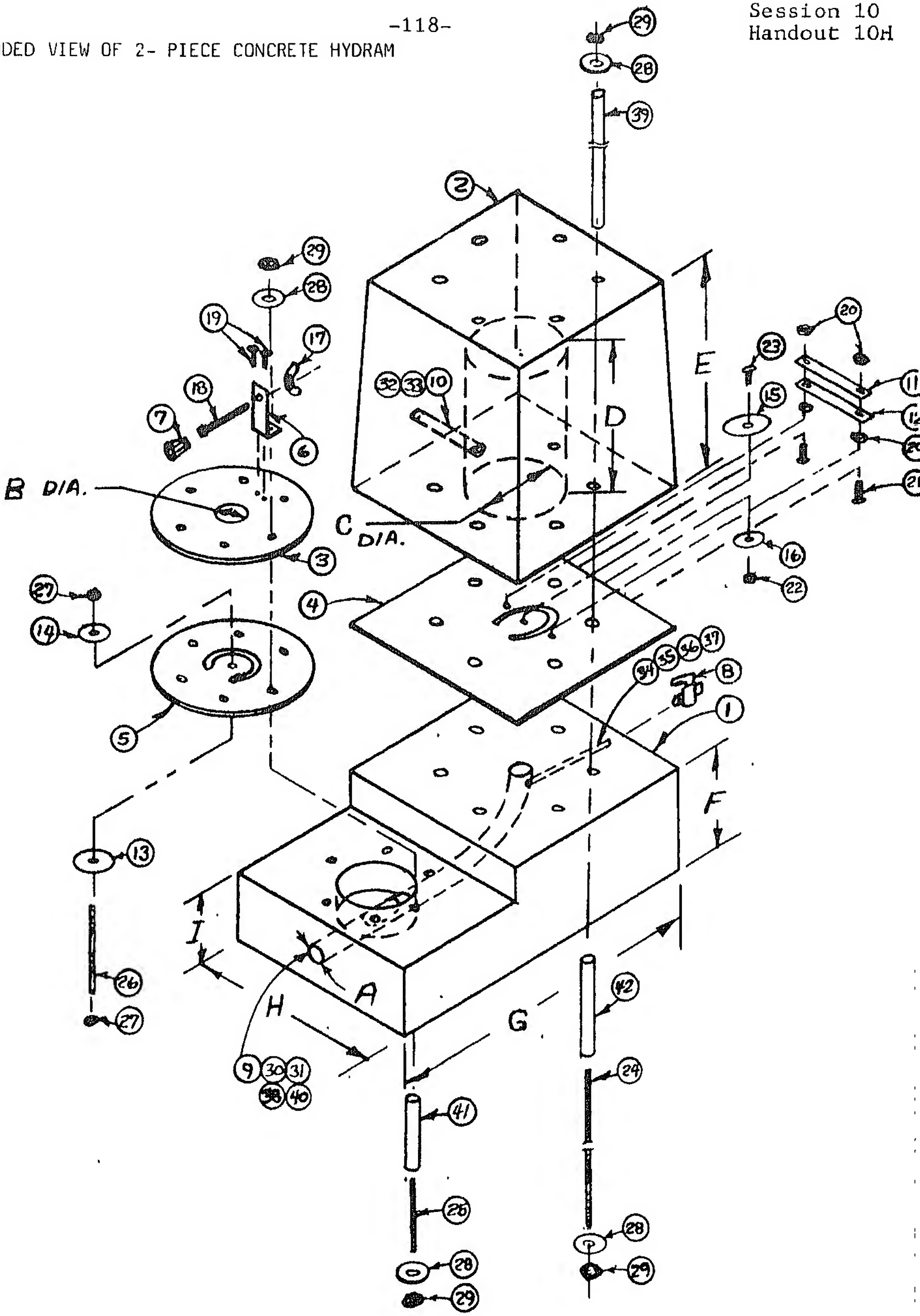
DRIVE PIPE DIAMETER IN MILLIMETERS	7.5	15	23	30	38	45	53	60
20	3	3	3	3	3	3	5	5
25	3	3	3	3	3	5	6	6
30	3	3	3	3	5	5	6	10
40	3	3	3	3	5	6	8	11
50	3	3	3	5	6	8	11	14
60	3	3	5	6	8	11	14	18
75	3	3	5	8	10	13	16	21
100	3	5	6	10	13	18	22	27
150	3	6	10	14	19	25	30	41
200	5	8	14	19	25	33	43	55

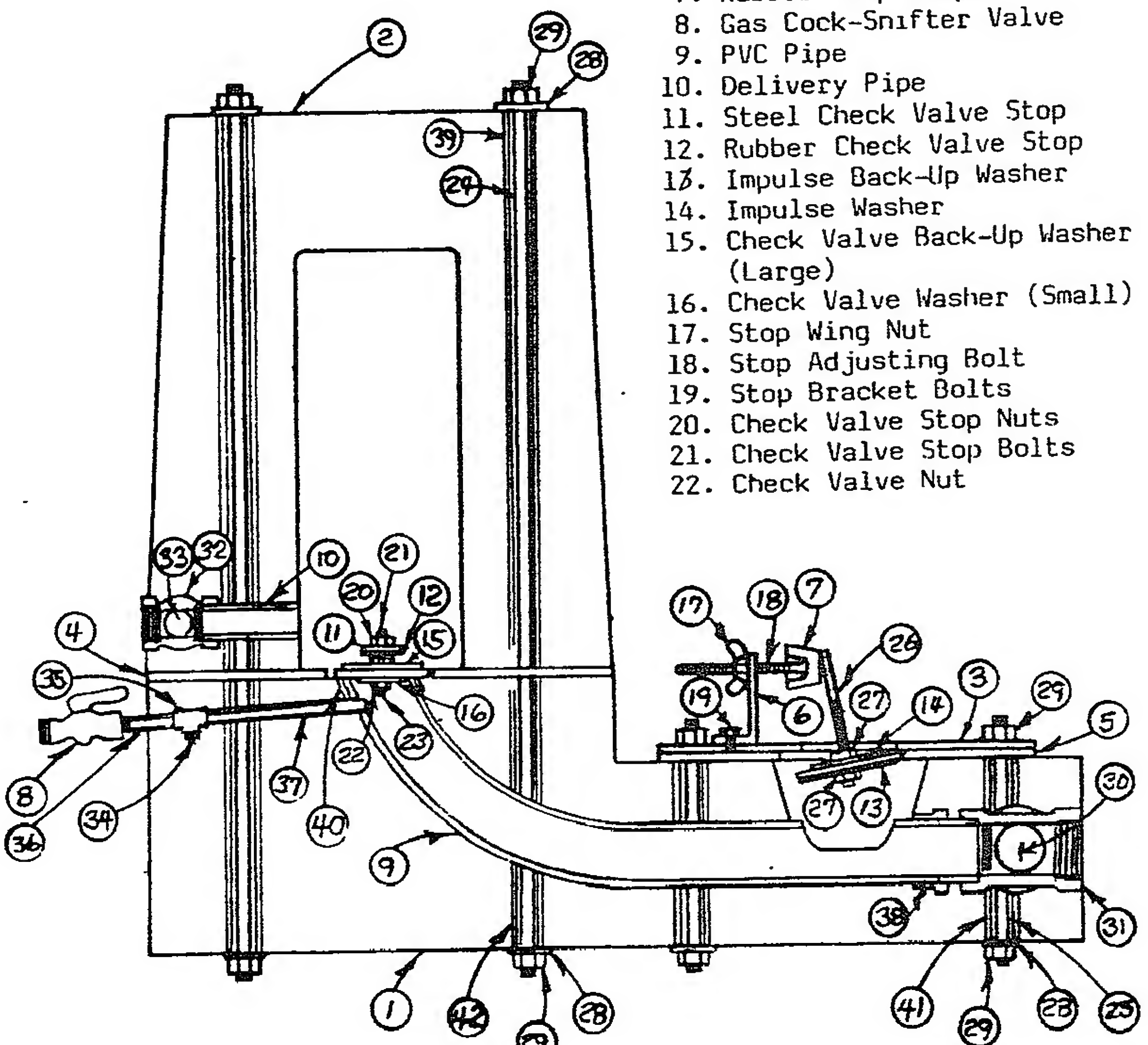




1. Hydram Body
2. Accumulator
3. Impulse Plate
4. Check Valve & Gasket
5. Impulse Valve & Gasket
6. Stop Bracket
7. Rubber Stop Bumper
8. Gas Cock-Snifter Valve
9. PVC Pipe
10. Delivery Pipe
11. Steel Check Valve Stop
12. Rubber Check Valve Stop
13. Impulse Back-Up Washer
14. Impulse Washer
15. Check Valve Back-Up Washer (Large)
16. Check Valve Washer (Small)
17. Stop Wing Nut
18. Stop Adjusting Bolt
19. Stop Bracket Bolts
20. Check Valve Stop Nuts
21. Check Valve Stop Bolts
22. Check Valve Nut
23. Check Valve Bolt
24. Althread Bolt (Accumulator)
25. Althread Bolt (Impulse Plate)
26. Althread Bolt (Impulse Valve)
27. Impulse Valve Hex Nut
28. Flat Washer
29. Hex Nut
30. Pipe Plug (Drive Pipe Size)
31. Steel Pipe Tee (Drive Pipe Size)
32. Pipe Tee (Delivery Pipe Size)
33. Pipe Plug (Delivery Pipe Size)
34. Pipe Plug (Snifter Pipe Size)
35. Pipe Tee (Snifter Pipe Size)
36. Snifter Pipe
37. Snifter Pipe
38. PVC Male Adapter
39. Accumulator Sleeve
40. PVC Coupling
41. Impulse Sleeve
42 Accumulator Base Sleeve

EXPLODED VIEW OF 2- PIECE CONCRETE HYDRAM

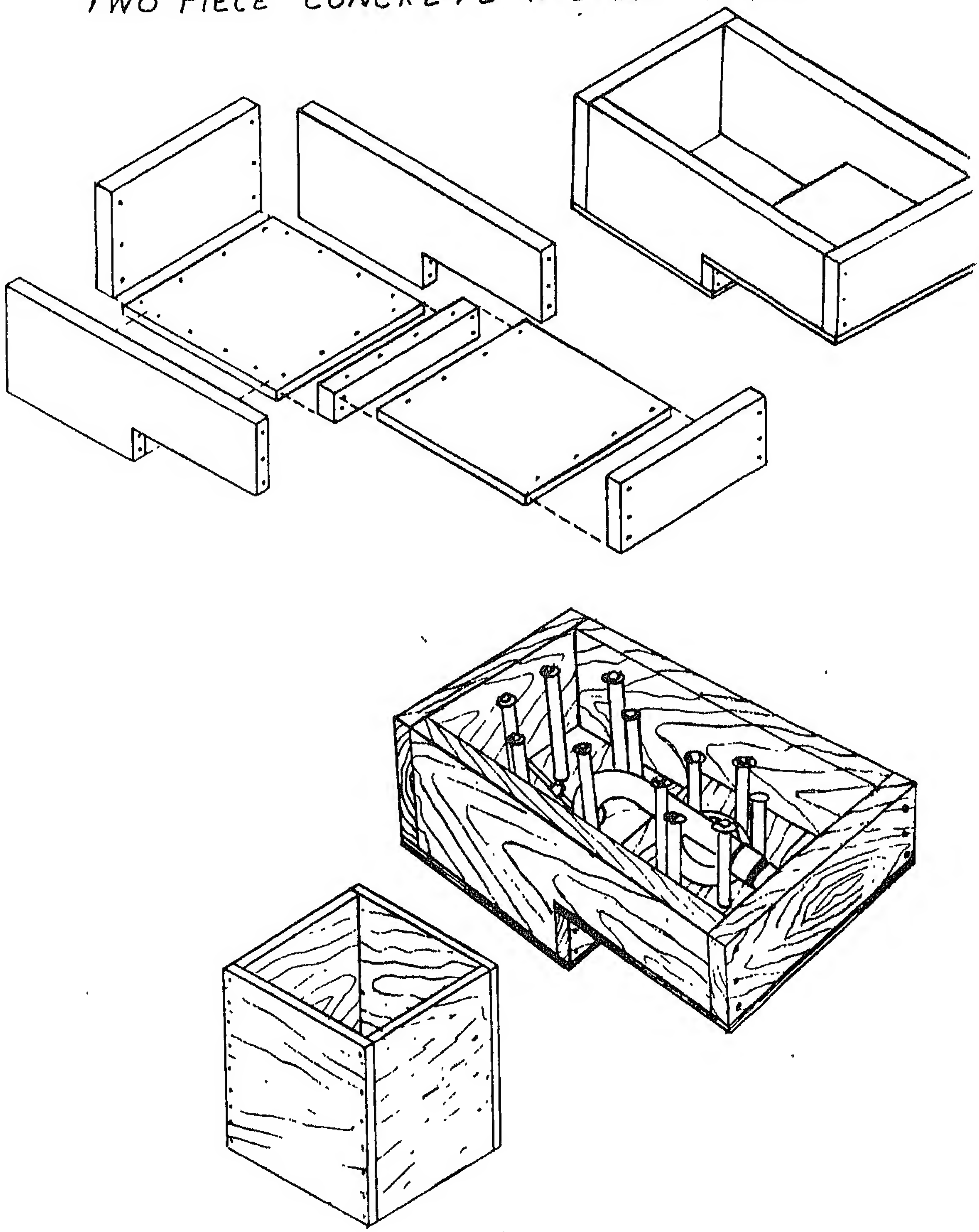




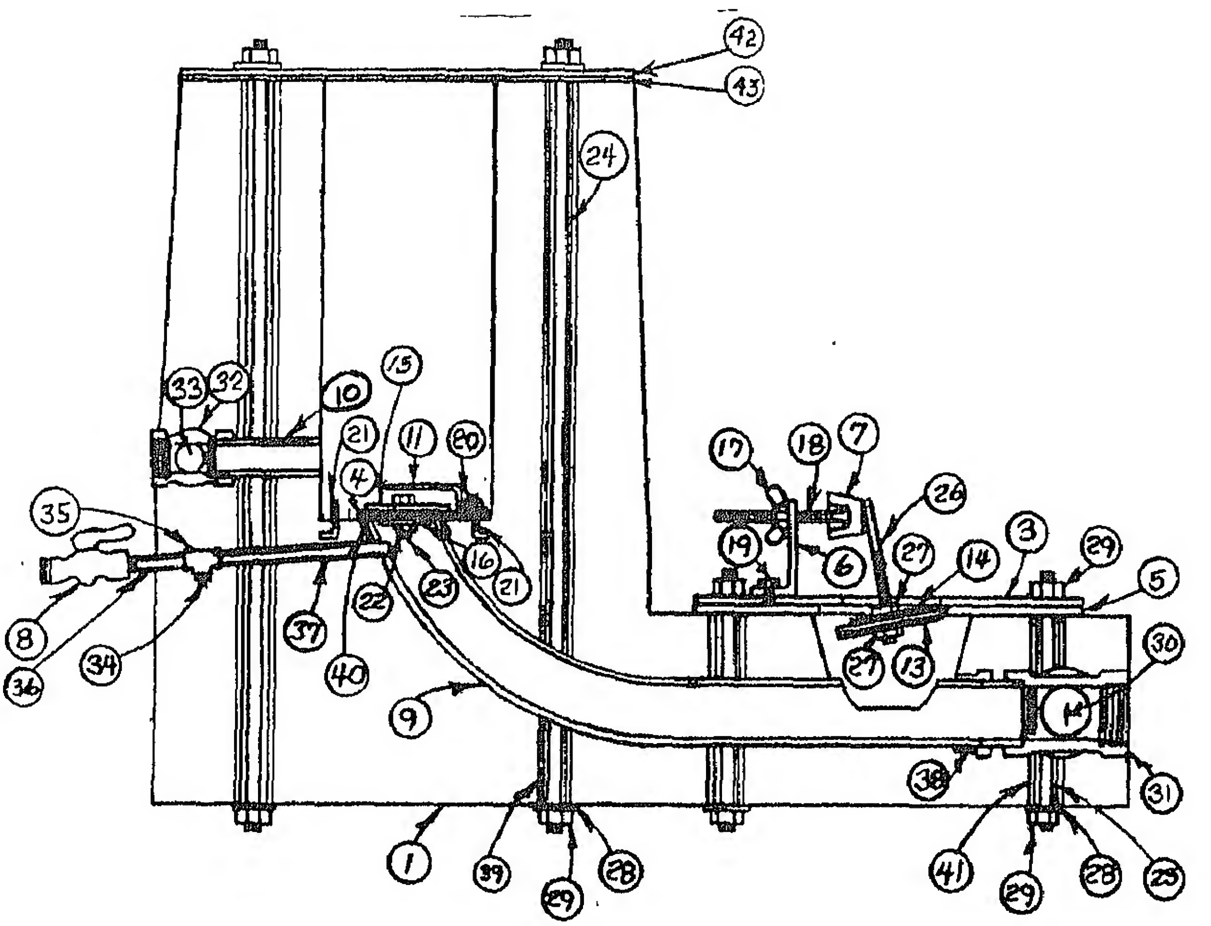
1. Hydram Body
2. Accumulator
3. Impulse Plate
4. Check Valve & Gasket
5. Impulse Valve & Gasket
6. Stop Bracket
7. Rubber Stop Bumper
8. Gas Cock-Snifter Valve
9. PVC Pipe
10. Delivery Pipe
11. Steel Check Valve Stop
12. Rubber Check Valve Stop
13. Impulse Back-Up Washer
14. Impulse Washer
15. Check Valve Back-Up Washer (Large)
16. Check Valve Washer (Small)
17. Stop Wing Nut
18. Stop Adjusting Bolt
19. Stop Bracket Bolts
20. Check Valve Stop Nuts
21. Check Valve Stop Bolts
22. Check Valve Nut
23. Check Valve Bolt
24. Althread Bolt (Accumulator)
25. Althread Bolt (Impulse Plate)
26. Althread Bolt (Impulse Valve)
27. Impulse Valve Hex Nut
28. Flat Washer
29. Hex Nut
30. Pipe Plug (Drive Pipe Size)
31. Steel Pipe Tee (Drive Pipe Size)
32. Pipe Tee (Delivery Pipe Size)
33. Pipe Plug (Delivery Pipe Size)
34. Pipe Plug (Snifter Pipe Size)
35. Pipe Tee (Snifter Pipe Size)
36. Snifter Pipe
37. Snifter Pipe
38. PVC Male Adapter
39. Accumulator Sleeve
40. PVC Coupling
41. Impulse Sleeve
42 Accumulator Base Sleeve

ATTACHMENT 10J

TWO PIECE CONCRETE HYDRAM FORM

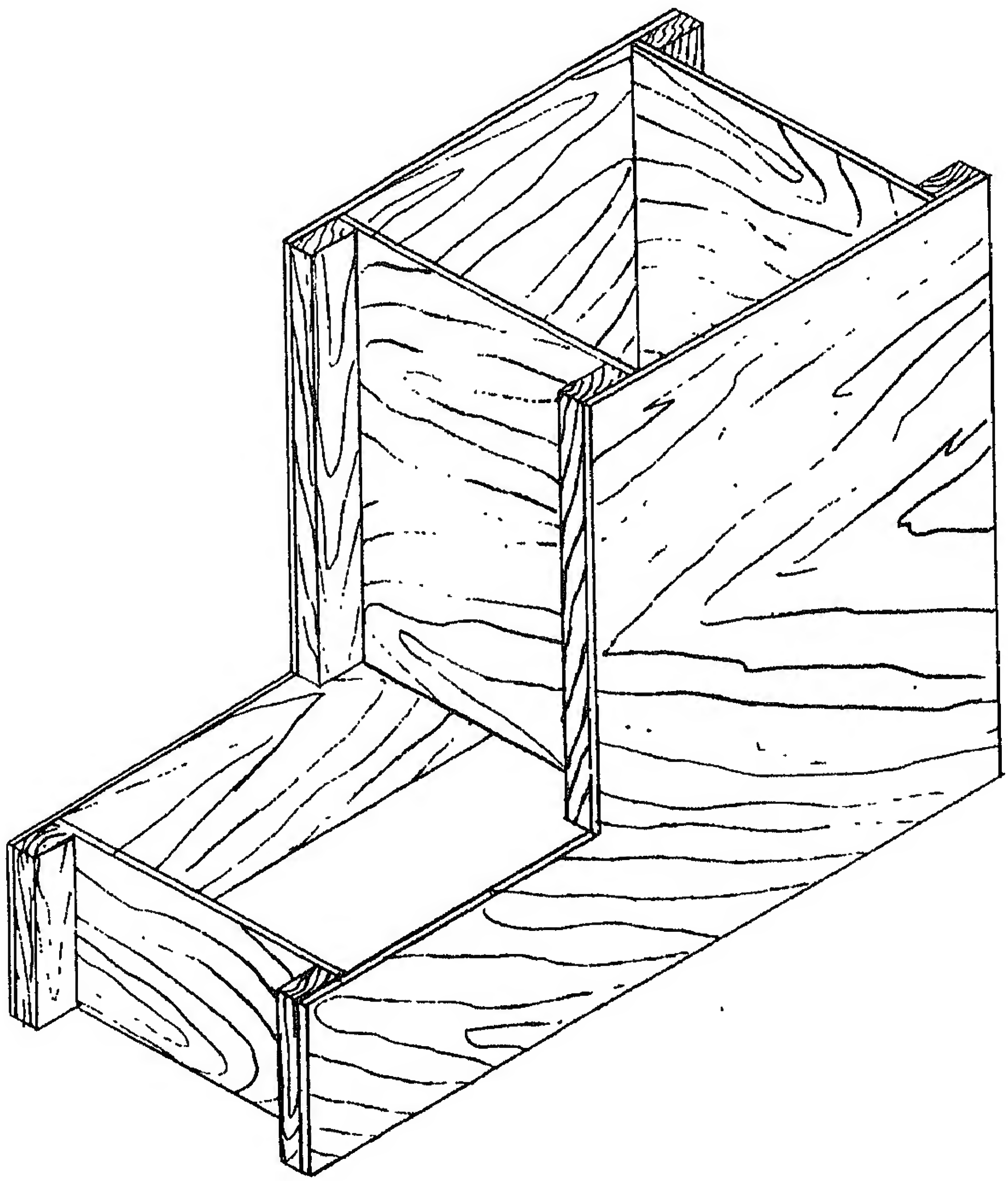


ONE-PIECE CONCRETE HYDRAM



1. Hydram body
2. gasket
3. impulse plate
4. check valve
5. impulse valve and gasket
6. stop bracket
7. rubber stop bumper
8. gas cock-shifter valve
9. PVC pipe
10. delivery pipe
11. check valve stop
12. - N/A -
13. impulse back-up washer
14. impulse washer
15. check valve back-up washer(large)
16. check valve washer (small)
17. stop wing nut
18. stop adjusting bolt
19. stop bracket bolts
20. check valve stop nuts
21. check valve stop bolts
22. check valve nut
23. check valve bolt
24. althread bolt (accumulator)
25. althread bolt (impulse plate)
26. althread bolt (impulse valve)
27. impulse valve hex nut
28. flat washer
29. hex nut
30. pipe plug (drive pipe size)
31. steel pipe tee (drive pipe size)
32. pipe tee (delivery pipe size)
33. pipe plug (delivery pipe size
34. pipe plug (snifter pipe size)
35. pipe tee (snifter pipe size)
36. snifter pipe
37. snifter pipe
38. PVC male adapter
39. accumulator sleeve
40. PVC coupling
41. impulse sleeve
42. accumulator plate
43. accumulator plate gasket

ONE PIECE CONCRETE HYDRAM FORM



ATTACHMENT 10M

A community of 100 people requires 20/gal/day/person, and 30 gpd/cow for 35 cows, and wants to use a concrete hydram.

h = 90'
H = 20'

A weir 2" wide and 4" deep has been put in the stream; 2' upstream from the weir, the distance form the mark on the stake, level with the top of the weir, to the water level is 1½". Assume an efficiency of 50%, determine the following:

- Q
- D
- d
- Accumulator diameter
- L
- Check valve opening
- Impulse valve opening
- T_S
- T_L
- Impulse valve thickness
- Impulse valve seat width
- Impulse valve backing thickness
- Check valve seat width
- Check valve backing thickness
- Number and size of bolts

ATTACHMENT 10M

A community of 100 people requires 20/gal/day/person, and 30 gpd/cow for 35 cows, and wants to use a concrete hydram.

h = 90'
H = 20'

A weir 2" wide and 4" deep has been put in the stream; 2' upstream from the weir, the distance form the mark on the stake, level with the top of the weir, to the water level is 1½". Assume an efficiency of 50%, determine the following:

- Q
- D
- d
- Accumulator diameter
- L
- Check valve opening
- Impulse valve opening
- T_s
- T_L
- Impulse valve thickness
- Impulse valve seat width
- Impulse valve backing thickness
- Check valve seat width
- Check valve backing thickness
- Number and size of bolts

MATERIALS: gravel, sand, cement, water, form lumber, plastic pipe, bowl, fittings, material for vapor barrier something to mix cement in.
Size and quantity of materials is dependent upon the hydram to be constructed. Following is an example of a typical list of materials for a 1" hydram.

1" CONCRETE HYDRAM MATERIALS LIST

1 1"x 12"x 8' lumber for body form	8 3/8 althread 36"
1 1"x 12"x 8' lumber for accumulator forms	26 3/8 lock washers
1 ¼"x 7" diameter steel plate	26 3/8 flat washers
1 3" PVC pipe cap	26 3/8 nuts
1 4" bowl	1 1" pipe plug
1 1'x 1'x ½ belting	1 1" pipe tee
1 7" diameter x ½" belting	1 ½" pipe plug
1 1"x 2" angle 1" long	1 ½" pipe tee
1 rubber stop bumper	1 ¼" pipe plug
1 ¼" gas cock	1 ¼" pipe tee
1 1" PVC pipe 2' long	2pcs. ¼" pipe 2" long
1 ½" nipple 1½" long	1 1" PVC male adaptor
2 2½" washer with 3/8" hole	1 ½" PVC pipe 22' long
2 1½" washer with 3/8" hole	1 1" PVC coupling
5/16" wing nut	½ lb 6d nails
1 5/16 x 2½" bolt	form oil
2 ¼ x½ bolt	2½ gal water
3 5/16 nut	32# cement
1 3/8 bolt 1" long	1 1/3 cu.ft. gravel
1 3" PVC pipe 18" long	1 1/6 cu.ft. sand
Handouts 10A - 10 L	shovels

PROCEDURES

NOTES

12. With all the tools and materials gathered, begin construction.

Phase I - Part Two

13. Start by constructing the hydram base form. (See handout 10J)

14. Next, bend the PVC pipe and cut to proper length and angles. Be sure to glue a coupling to the check valve end to increase the seat area.

15. Notch out bottom of plastic bowl to fit upon the PVC pipe: with the bowl and pipe held together, mark where the pipe touches the inside of the bowl; then, using coping saw, cut along this line. Attach male adapter and the plugged tee to input end of pipe. The plugged tee serves to prevent the pipe from turning within the concrete. Welding a piece of metal onto the coupling would also work.

16. Drill holes in the bottom of the form for the bolt pattern around the impulse valve and the accumulator.

17. Center accumulator form pipe on the inside of the form and draw a circle around it. Drive three 6d nails one-half way in, 120 degrees apart through the circle, making compensation for the thickness of the accumulator form pipe.

18. Drill hole in PVC pipe for snifter. Drill another hole in form for the other end of snifter. Snifter pipe should have a plugged tee in the middle or a piece of metal welded to the side of it to eliminate turning.

19. An elliptical rubber washer should be cut out and nailed where the check valve end of the PVC pipe comes in contact with the form. This is to recess the concrete around the check valve seat to insure a good seat.

PROCEDURES | NOTES

20. Bolt sleeves to form using althread, nuts and washers.

21. Tie PVC pie down to form using tie-wire.

22. Pour the base of the hydram using the following concrete formula: 8 parts gravel, 7 parts sand, 2 parts cement, and water to proper consistency. Tap on the form sides while pouring to prevent air pockets. Cover concrete with a vapor barrier such as visqueen, then cover entire pour with insulation. Draw pattern for impulse valve plate and send to metal shop.

Phase II

23. After the hydram base has had sufficient time to set (usually about 2 days), remove form and place hydram base right side up on blocks so that the bolt holes on the bottom can be reached.

24. Place a sheet of plastic or wax paper or anything that will prevent a concrete marriage and that won't wrinkle on top of the accumulator end of the hydram.

25. Place althread and sleeves through bolt pattern at accumulator with nuts and washers on both ends. Tighten until sleeves are rigid.

26. Build form for accumulator as shown in Handout 10J.

27. Place accumulator form pipe over the three nails sticking up through the concrete at the check valve. Pack with sand to prevent pipe from floating up in concrete. Cap end of accumulator form pipe with tape or PVC cap.

PROCEDURES | NOTES

28. Place accumulator form on top of hydram base and install the delivery pipe connection between this form and the accumulator form pipe.

29. Pour accumulator form full of concrete using the same mixture ratio as used in step #22.

30. Cover with a vapor barrier such as visqueen and insulation.

Phase III

31. After concrete has had sufficient time to set up (about one to two days), remove form.

32. Using a large piece of paper, make a pattern from the hydram base for both the impulse valve rubber and the accumulator check valve rubber.

33. Cut out the rubbers according to the pattern. If the rubber is too thick to allow free movement of the valves, a v-notch may need to be cut into the rubber at the flex point of the valve.

34. Drill and cut out a piece of sheet metal for the impulse plate and attach stop bracket.

35. Install althread, bolt, nuts and washers on both pieces of rubber as shown in the attachment.

36. Bolt accumulator to base with check valve rubber for a gasket.

37. Bolt impulse valve rubber and plate to hydram base.

38. Install stroke adjustment bolt locknut and rubber bumper.

PROCEDURES

NOTES

Phase IV

39. Install ram to drive pipe and delivery pipe. Start up. Adjust for amount of flow available.

40. Have the trainees determine the flow rate into and out of the hydram and determine the efficiency.

41. Discuss with the trainees what they feel the advantages and disadvantages of this ram might be and when they might be important.

SESSION 11: HYDRAM COMPONENT DESIGN CRITERIA Time: 1-1½ hours

OBJECTIVES: By the end of this session, trainees shall be able to:

- describe how each hydram component is or can be made, and the advantages and disadvantages of each design, including longevity, serviceability, reliability;
- describe how the configuration of the components affect their function and the overall efficiency of the hydram; and
- select hydram component appropriate for their sites.

OVERVIEW: Trainees will examine advantages and disadvantages of manufactured and fabricated ram components, and configurations. Combining this information with information about locally available materials and skills, they will determine ram construction that is most applicable.

MATERIALS:
- flipchart/chalkboard
- slides, slide projector
- actual parts, as available (see trainer note)

NOTE: The handouts for this session will be very helpful in presenting the information on the individual components but having the actual components available would greatly increase the effectiveness of this session. If in the country that the trainees will be working there is one brand or type of hydram predominantly being used, it would be most advantageous to have a hydram of that type at the training site. The types and brands of the components, the trainees will most likely encounter are the ones that the greatest amount of attention should be given to.

PROCEDURES	NOTES
1. Review the purpose of this activity.	
2. Ask the trainees to list the components of the hydram and write them on the flipchart/board. It should include the drive pipe, impulse valve, snifter, check valve, accumulator and delivery pipe.	
3. Distribute Handout 11A.	
4. Using handout 11A, ask the trainees to point out any problems or advantages of each of the components. Fill in any information the trainees leave out.	Slides can be used very effectively as well.
5. Repeat steps 3 and 4 using handouts 11B and 11C.	
6. Once the trainees have a good understanding of the components, discuss with them all the possible configurations of the components and how the placement of a particular component affects the overall efficiency of a hydram. The configuration possibilities should at least include: - the location of the impulse valve (either before or after the accumulator); - the angle of the impulse valve (on the top, side, or bottom of the hydram); - the placement of the snifter and how it affects its function; - the possibility of more than one impulse valve (as in the case of larger Blake Hydrams); and - the angle of the check valve (either vertical, horizontal, or up-side down),	

PROCEDURES

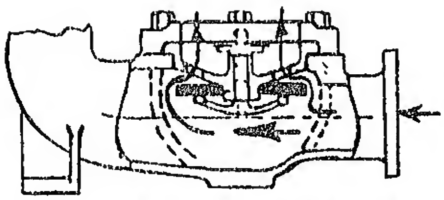
- the size and shape of the accumulator, and

- how the configuration affects the water's path.

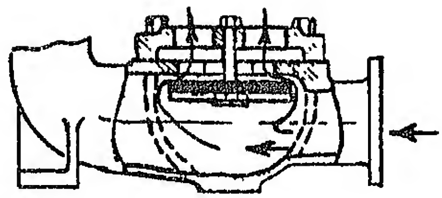
7. Make a transition to Session 12, indicating that this information will also be used to consider choices among hydram designs.

NOTES

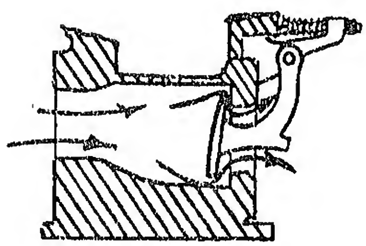
TYPICAL IMPULSE VALVES



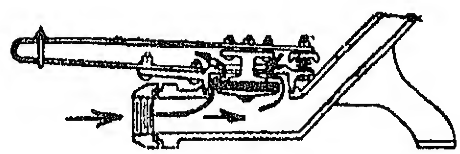
BLAKE RUBBER WASHER STYLE



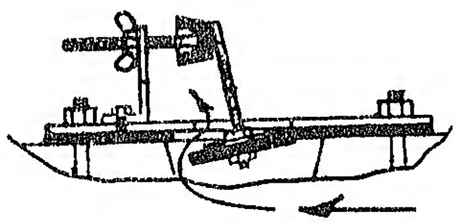
PLUNGER TYPE



SKOOKUM

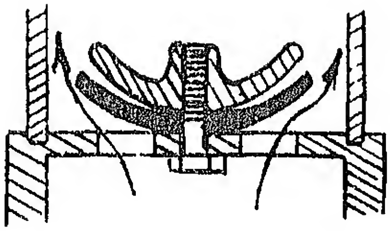


RIFE

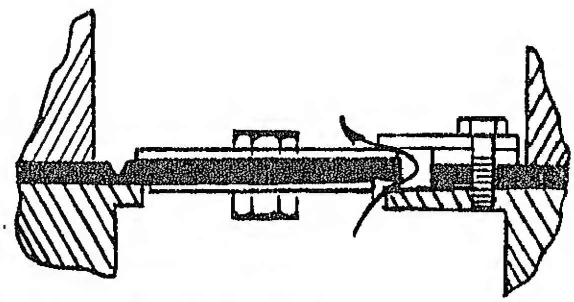


PERENNIAL STYLE

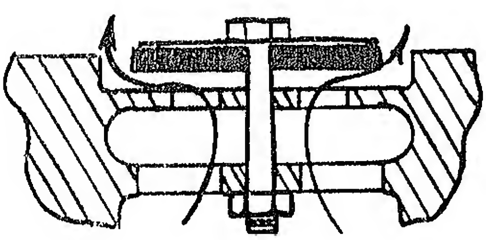
TYPICAL CHECK VALVES



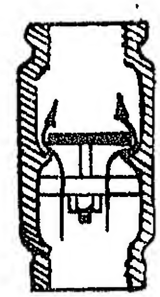
BLAKE RUBBER WASHER TYPE



PERENNIAL TYPE



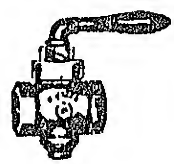
PLUNGER TYPE

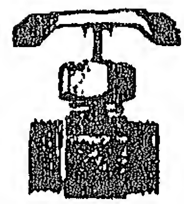


MODIFIED CHECK VALVE

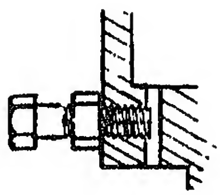
TYPICAL SNIFTERS

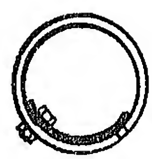

standard plumbing snifter

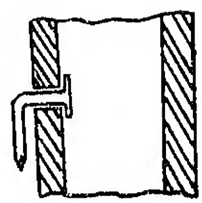

gas cock

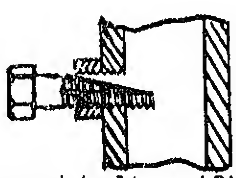

needle valve

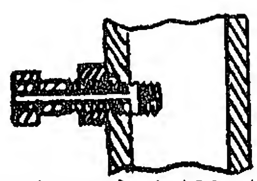

orifice

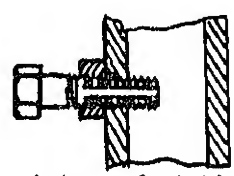

bolt snifter


rubber flap check


nail check


grooved bolt snifter


external drilled bolt snifter


internal drilled bolt snifter

SESSION 12

SESSION 12: HYDRAM SELECTION — Time: 1½ - 3 hours

OBJECTIVES: By the end of this session, trainees shall be able to:

- identify factors involved in selecting hydrams;
- describe advantages and disadvantages of various ram construction, including manufactured rams;
- identify factors which will support/impede the development of a hydram system.

OVERVIEW: This session pulls together much of what has been learned to date, and organizes most of the issues to be considered in the installation of a hydram.

MATERIALS: chalkboard or flipchart, chalk or markers
Handout 12A

TRAINERS NOTES:

1. Key issues that have been raised in other sessions include:

   - funding sources for projects (Sessions 9, 11)
   - types of rams currently being used (Session 2)
   - available materials and costs (Sessions 9, 11)
   - transport available (Session 2)
   - existence of local industry capable of fabricating parts or complete rams (Session 2)

2. The advantages of manufactured rams will be discussed during this session. The trainer should identify brands available in-country, collect and duplicate literature.

PROCEDURES:

1. Identify the objectives of the session.

2. Ask the trainees what factors need to be considered in selecting a hydram and write these factors on flipchart. As in handout they should include cost, serviceability. availability, simplicity of design, ease of transportation, longevity, and efficiency.

3. Review manufactured rams available in-country. List all the types of hydrams the trainees might have to choose from. The list may include concrete, factory made, modified pipefitting, fabricated pipefitting, and welded steel.

4. Ask participants to discuss each type of ram and how its characteristics lend themselves to the factors previously discussed; fill in chart.

5. Summarize by asking the trainees what type of hydram they will most likely be installing and any other information which is pertinent such as funding sources for hydram projects, where to buy pipe and fittings and where there might be some local industries that should be involved in the fabrication of parts or whole hydrams.

6. Ask participants what other factors support/impede/affect selection. List on flipchart.

7. Ask the trainees to form groups of six and as a group determine the ideal ram construction and configuration for their site. Inscruct them to consider:

   - manufactured rams available,

   - limitations of component parts, manufactured or built,

PROCEDURES:

- local skills available for construction, repair and maintenance,
- maintenance schedule and responsible parties,
- volume of water to the pump, and
- cost.

Allow the groups 25 minutes for this.

8. Design should be critiqued, according to the criteria. If all information is not available, ask participants how they would get it. Discuss the implications of craftmanship.

9. Ask participants if there is anything else they need to know before they begin construction. Answer any questions.

NOTES:

HANDOUT 12A - HYDRAM COMPARISON

Scale: 1 (best) to 6 (worst)

	CONCRETE	MODIFIED PIPE FITTING	FABRICATED PIPE FITTING	MANUFACTURED HYDRAM	WELDED STEEL	PLASTIC*
Cost	1 inexpensive	4 inexpensive	3 inexpensive	6 expensive	5 moderate	2 cheap
Serviceability	5 hard to repair the concrete	3 parts are hard to repair and usually requires replacement	2 sometimes difficult to get to the check valve	1 parts easily made or replaced	4 requires a welder	6 poor
Availability						
Simplicity of Design	6 requires the greatest amount of time to construct	1 parts just screw together	3 most parts screw or bolt together but requires some metal working	4 most parts are cast & sometimes the rubber parts are field fabricated	5 requires welding but no unique metal shapes	2 easy to build but requires glueing
Ease of Transportation	6 extremely heavy	2 small and not very heavy	3 small & not very heavy	5 heaviest of the ferrous hydrams	4 heavy & bulky	1 very light
Longevity	3 if it does not freeze it should last as long as a mfg. ram	5 will last about 1 yr.	4 no longevity studies done yet, but should last a long time	1 history of up to 25 yr. without service	2 should last about as long as a mfg. ram	6 will last about one month
Efficiency	..........very little difference if built properly....................					

* training device only

SESSION 13: INTER-RELATIONSHIPS WITHIN THE HYDRAM Time: 11-15 hour

OBJECTIVES: The trainees will verify by experimentation the inter-relationships within a hydram including:

1) the effects of the h:H ratio on efficiency,

2) frequency on maximum h:H,

3) frequency on efficiency and q and Q

4) amount of air in accumulator on efficiency

5) drive pipe length on efficiency,

6) drive pipe diameter on efficiency,

7) snifter on efficiency, and

8) drive pipe material on efficiency

The trainees will describe the extent to which they can vary the factors that affect efficiency, and produce an acceptable amount of water.

OVERVIEW: A series of 8 experiments will be conducted by groups of 3-4 participants. The number of experiments each group conducts will depend on the size of the total group and the amount of time available. This activity is key in providing participants with experience and confidence in understanding and manipulating hydrams, and understanding the range of skills, materials, tools and equipment involved in a hydram project.

MATERIALS: Handout 13, exercises 1-8
a water source with sufficient head to operate one or more hydrams, enough working hydrams for one to each group, drive pipes (all steel except one PVC)

TOOLS: pipe wrenches, stop watches or watches with a seconds function, buckets of known capacity, means of measuring drive head such as transit or sight level, pressure gauges, pressure relief valves

TRAINER NOTES ON TIMING FOR EXPERIMENTS

The time it should take for each series of experiments is as follows:

1)	h:H ratio's effect on efficiency	2 hours
2)	frequency's effect on maximum h:H	1½ hours
3)	frequency's effect on efficiency, Q and q	2½ hours
4)	volume of air in accumulator's effect on efficiency	2 hours
5)	drive pipe length's effect on efficiency	4 hours
6)	drive pipe diameter's effect on efficiency	2½ hours
7)	snifter's effect on efficiency	1½ hours
8)	drive pipe material's effect on efficiency	2 hours

Allow 1½ hours for the introduction to this session (procedure steps 1-4) and 2-3 hours for the groups to analyze their findings (step 6) and 3 hours for the group presentations and discussion.

The number of experimental stations available and the time an experiment actually takes, may mean that each group does 2-3 experiments each. It's a good idea to have more than one group run an experiment to verify results.

PROCEDURE:

1. Describe the objectives of this session.

2. Divide the trainees into groups of 3-4, making sure each group contains a cross-section of technical abilities.

3. Give each group the task and procedure sheets for the experiments which you want them to perform.

4. Assign groups to work spaces and ask them to take 15 minutes to

   - decide how they will work together,

   - get clear about procedures, task,

   - make assignments for presentation, write-up.

5. The groups follow the procedures on the task and procedure sheets.

6. After the experiments are finished, the trainees meet with their groups for 2-3 hours to analyze the data collected, to plot the results of their experiments onto the graphs provided in the handout (all except for the snifter experiment which needs no graph), and to define the generalizations that can be made and the applications.

7. A representative from each group presents the task, procedure, results, generalizations, and applications for the experiments performed.

8. A discussion follows about what has been learned and what wasn't learned that perhaps should have been learned.

9. Ask participants to describe how start up of ram might be different at actual installation vs. this experimental arrangement.

NOTES

Each group of 3-4 should possess a range of technical abilities.

Each group will need to assign responsibility for timing the experiment, measuring Q_w, maintaining pressure gauge, recording data, reporting out, analyzing data.

The trainers must be available to participants as necessary to respond to questions, ensure that procedures and conclusions are clear and on target. Trainer should encourage groups to review their work at the end of the first block of work time.

See Guide to Users for setting up experimental stands.

Exercise 1 - Part I

TASK: DETERMINE THE EFFECT THE h:H RATIO HAS ON EFFICIENCY

Variables: efficiency (n), water delivered (q), water used (Q), time of experiment, water wasted (Q_w)

Controlled Variables: Delivery head (h)

Constants: Drive head (H), frequency (f), volume of air in the accumulator

Range: 2:1 to 20:1

PROCEDURE:

1. Install a hydram to a drive head.
2. Accurately measure the drive head.
3. Attach and set an adjustable pressure relief valve and a pressure gauge to the discharge.
4. Start the hydram.
5. Open the snifter in order to fill the accumulator with air and then close the snifter for the duration of the experiment.
6. Calculate the impulse valve frequency.
7. Simultaneously measure the time of the experiment, water delivered (q) and water wasted (Q_w).
8. Calculate the efficiency (n).
9. Repeat the experiment making sure to keep the drive head, frequency and the volume of air in the accumulator the same and change the delivery head in order to develop a new h:H ratio.

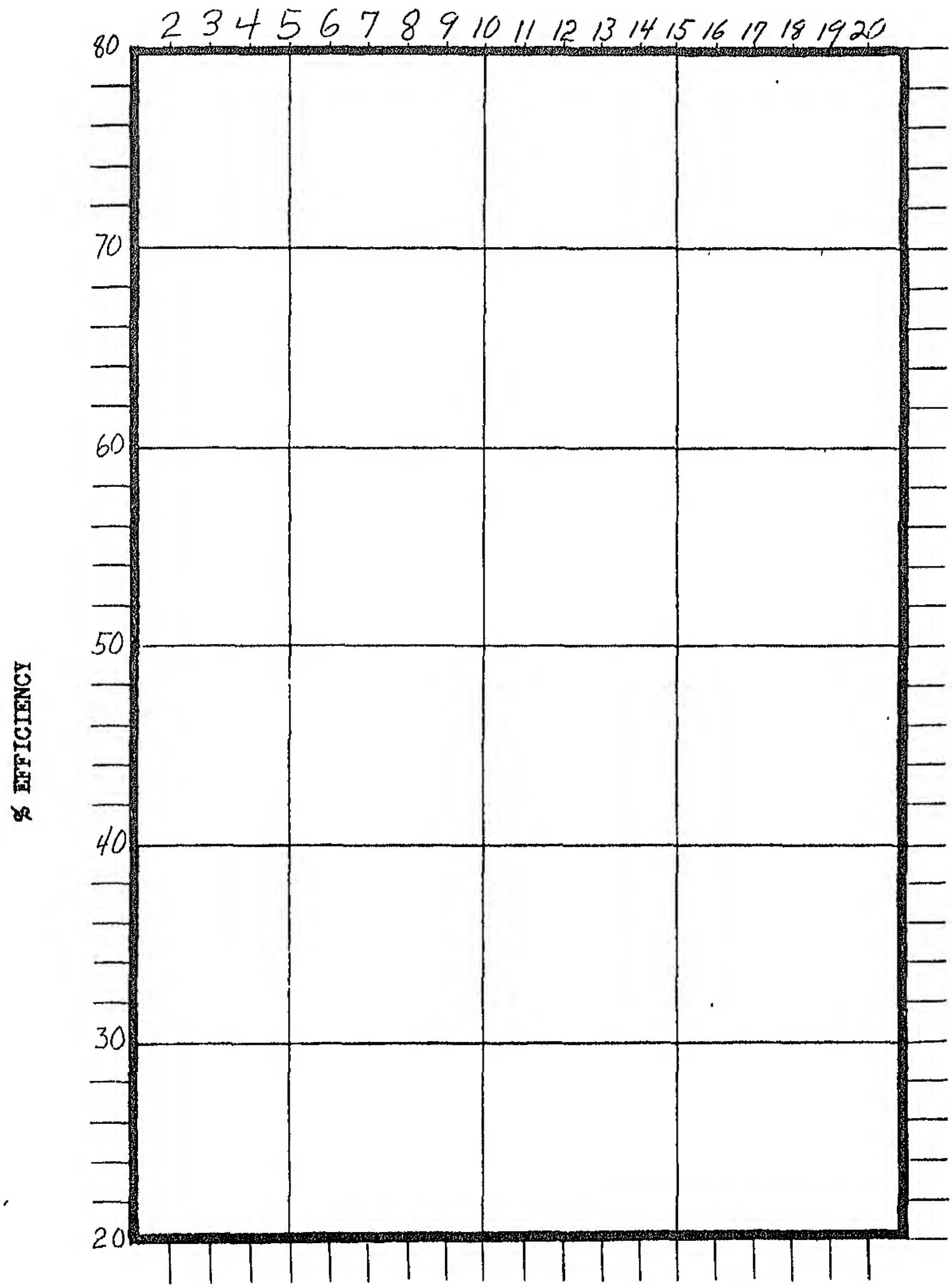
Exercise 1 - Part II

TASK: DETERMINE THE EFFECT THE h:H RATIO HAS ON EFFICIENCY

Experiment #										
h:H ratio										
H										
h										
Qw										
q										
Q										
f										
s										
w										
t										
n										
Notes:										

Exercise 1 - Part III

THE EFFECT OF THE DELIVERY HEAD TO DRIVE HEAD RATIO ON EFFICIENCY



Exercise 2 - Part I

TASK: DETERMINE THE EFFECT OF THE FREQUENCY ON THE MAXIMUM DELIVERY HEAD TO DRIVE HEAD RATIO

Variables: delivery head (h), water used (Q), water wasted(Q_w), water delivered (q)

Controlled Variables: amount of air in the accumulator, frequency (f)

Constants: drive head

Range: high frequency to low

PROCEDURES:

1. Install a hydram to a drive head.
2. Accurately measure the drive head.
3. Attach and set an adjustable pressure relief valve and a pressure gauge to the discharge.
4. Start the hydram.
5. Open the snifter in order to fill the accumulator and then
6. Set the frequency to as fast as possible.
7. With delivery valve shut measure the maximum delivery head with a pressure gauge. (Make certain that the hydram that is used is designed for the pressures that will be encountered.)
8. Repeat the experiment while slowing down the frequency by even increments making certain that the volume of air in the accumulator remains the same.
9. From the pressure reading calculate the delivery head and the h:H ratio.

TOOLS AND MATERIALS NEEDED:

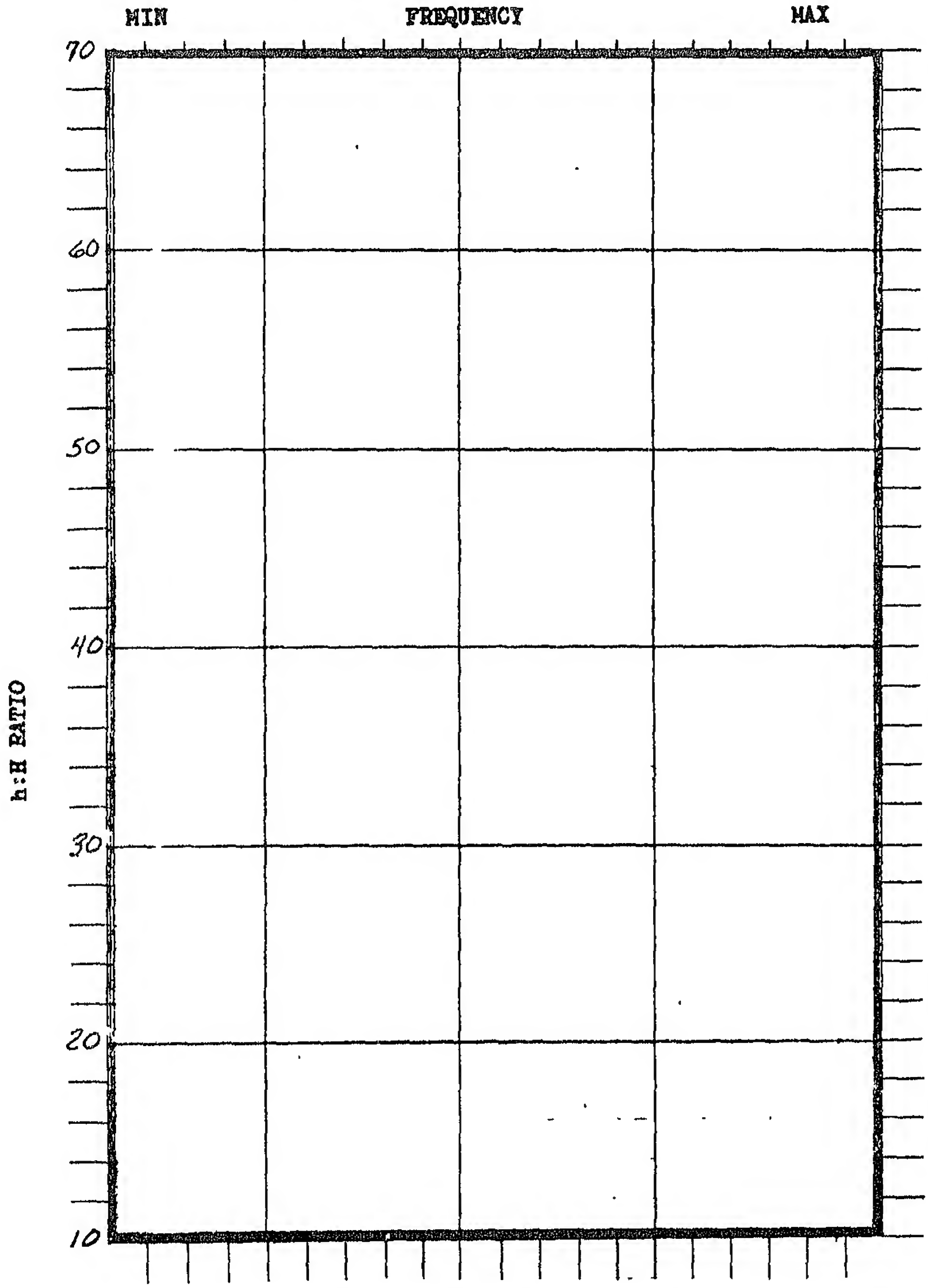
Exercise 2 - Part II

TASK: **Determine the effect of the frequency on the maximum delivery head to drive head ratio**

Experiment #										
h:H ratio										
H										
h										
Qw										
q										
[illegible]										
[illegible]										
[illegible]										
w										
L										
n										
Notes:										

Exercise 2 - Part III

THE EFFECT OF THE FREQUENCY ON THE MAXIMUM DELIVERY HEAD TO DRIVE HEAD RATIO



Exercise 3 - Part I

TASK: DETERMINE THE EFFECT OF FREQUENCY ON EFFICIENCY, QUANTITY OF WATER ENTERING THE HYDRAM AND QUANTITY OF WATER DELIVERED.

Variables: time of the experiment, efficiency (n), water used (Q), water delivered (q), water wasted (Q_w)

Controlled Variables: frequency

Constants: drive head (H), delivery head (h), volume of air in the accumulator

Range: slow to fast

PROCEDURE:

1. Install a hydram to a drive head.
2. Accurately measure the drive head.
3. Attach and set an adjustable pressure relief valve and a pressure gauge to the discharge.
4. Start the hydram.
5. Open the snifter in order to fill the accumulator with air and then close the snifter for the duration of the experiment.
6. Calculate the impulse valve frequency.
7. Simultaneously measure the time of the experiment, water delivered (q) and water wasted (Q_w).
8. Calculate the efficiency (n).
9. Repeat the experiment making certain to keep the volume of air in the accumulator, drive head, and delivery head the same while changing the frequency.

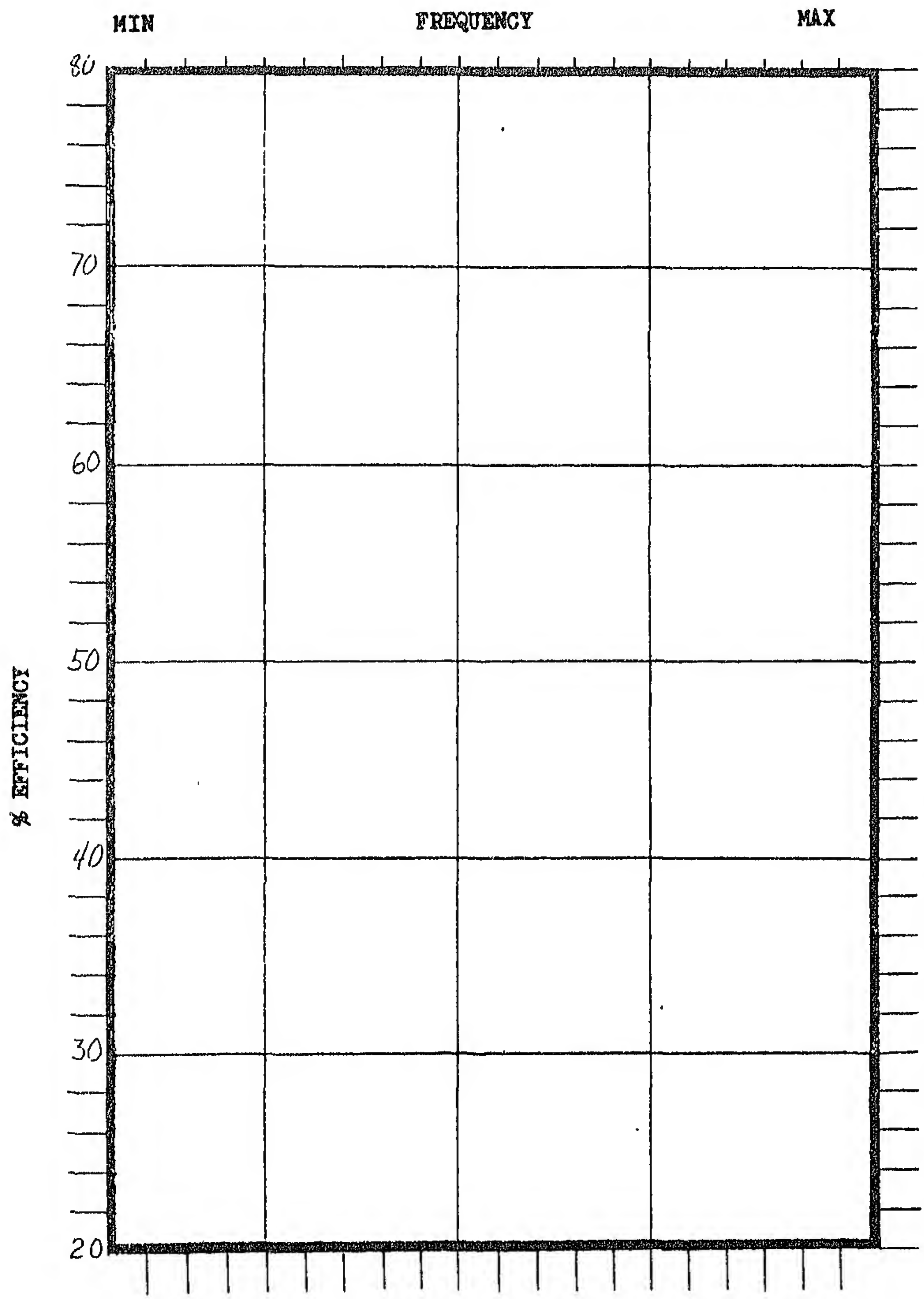
Exercise 3 - Part II

TASK: **DETERMINE THE EFFECT OF FREQUENCY ON EFFICIENCY, QUANTITY OF WATER ENTERING THE HYDRAM AND QUANTITY OF WATER DELIVERED**

Experiment #										
h:H ratio										
H										
h										
Qw										
q										
Q										
f										
s										
w										
t										
n										
Notes:										

Exercise 3 - Part III

THE EFFECT OF FREQUENCY ON EFFICIENCY, QUANTITY OF WATER ENTERING THE HYDRAM AND QUANTITY OF WATER DELIVERED



Exercise 4 - Part I

TASK: DETERMINE THE EFFECT OF THE VOLUME OF AIR IN THE ACCUMULATOR ON EFFICIENCY.

Variables: time of the experiment, efficiency (n), water wasted (Q_w), water pumped (q), water used (Q)

Controlled Variables: volume of air in the accumulator

Constants: drive head (H), delivery head (h), frequency (f)

Range: no air - 24" of air

PROCEDURES:

1. Install a hydram to a drive head.
2. Accurately measure the drive head.
3. Attach and set an adjustable pressure relief valve and a pressure gauge to the discharge.
4. Start the hydram.
5. Open the snifter in order to fill the accumulator with air and then close the snifter for the duration of the experiment.
6. Calculate the impulse valve frequency.
7. Simultaneously measure the time of the experiment, water delivered (q) and water wasted (Q_w).
8. Calculate the efficiency (n).
9. Repeat the experiment making certain to keep the drive head, delivery head and frequency the same while changing the volume of air in the accumulator.

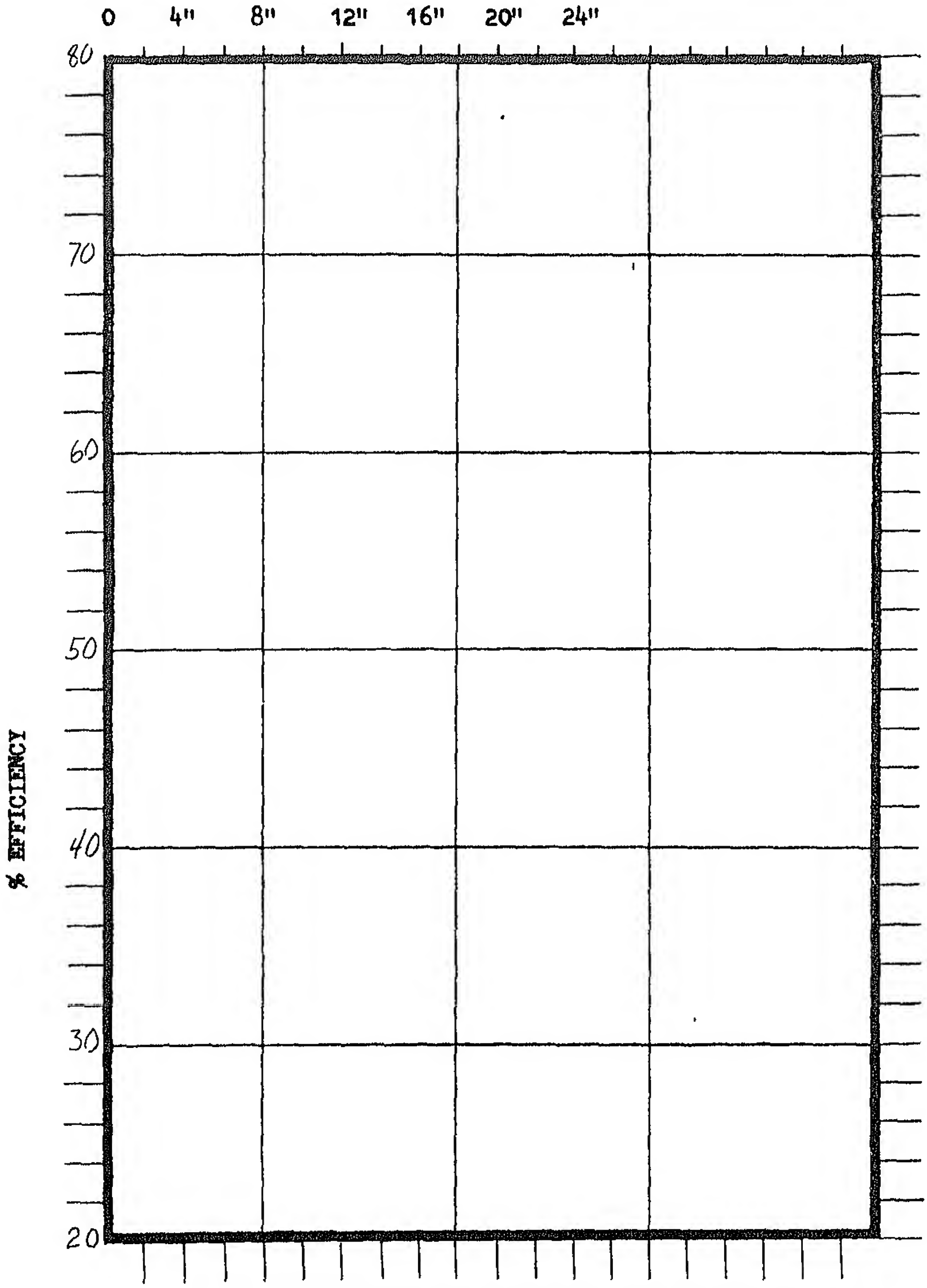
Exercise 4 - Part II

TASK: **Determine the effect of the volume of air in the accumulator on efficiency**

Experiment #										
h:H ratio										
H										
h										
Qw										
q										
Q										
f										
s										
w										
t										
n										
Notes:										

Exercise 4 - Part III

THE EFFECT OF THE VOLUME OF AIR IN THE ACCUMULATOR ON EFFICIENCY



Exercise 5 - Part I

TASK: DETERMINE THE EFFECT OF THE DRIVE PIPE LENGTH ON EFFICIENCY

Variables: efficiency (n) water wasted (Q_w) water used (Q) water delivered (q), time of the experiment

Controlled Variables: length of the drive pipe

Constants: frequency (f), drive head(H), delivery head (h) volume of air in the accumulator

Range: 10' - 80'

PROCEDURE:

1. Install a hydram to a drive head.
2. Accurately measure the drive head.
3. Attach and set an adjustable pressure relief valve and a pressure gauge to the discharge.
4. Start the hydram.
5. Open the snifter in order to fill the accumulator with air and then close the snifter for the duration of the experiment.
6. Calculate the impulse valve frequency
7. Simultaneously measure the time of the experiment, water delivered (q) and water wasted (Q_w).
8. Calculate the efficiency (n).
9. Repeat the experiment making certain to keep the volume of air in the accumulator, drive head(H), deliveryhead (h) and frequency the same while changing the length of the drive pipe.

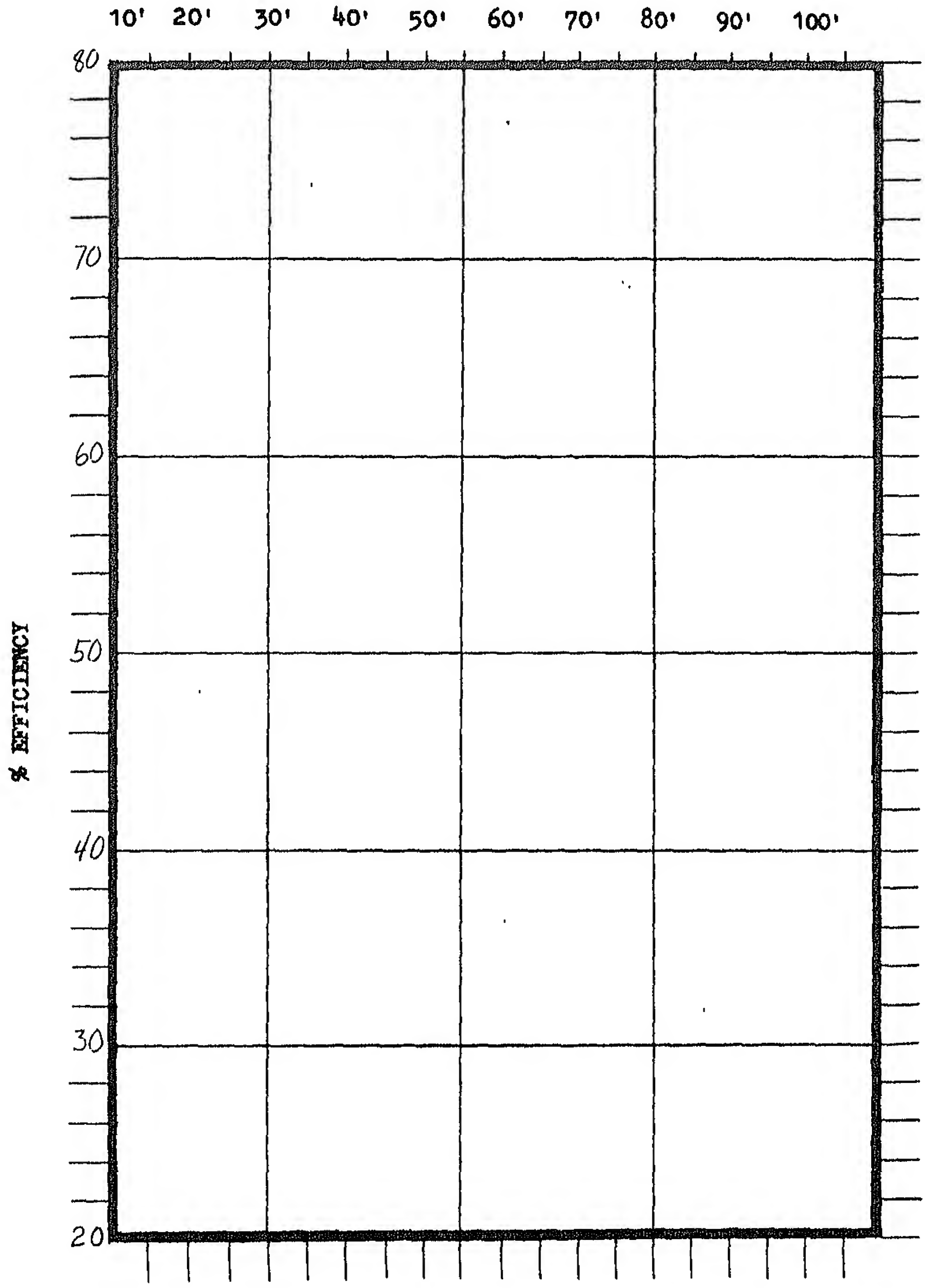
Exercise 15 - Part II

TASK: DETERMINE THE EFFECT OF THE DRIVE PIPE LENGTH ON EFFICIENCY

Experiment #										
h:H ratio										
H										
h										
Qw										
q										
Q										
f										
s										
w										
t										
n										
Notes:										

Exercise 5 - Part III

THE EFFECT OF THE DRIVE PIPE LENGTH OF EFFICIENCY



Exercise 6 - Part I

TASK: DETERMINE THE EFFECT OF THE DRIVE PIPE DIAMETER ON EFFICIENCY.

Variables: water wasted (Q_w), water used (Q), water delivered (q), time of the experiment

Controlled Variables: drive pipe diameter (D)

Constants: drive head (H), delivery head (h), frequency (f), volume of air in the accumulator

Range: ½, 3/4, 1"

PROCEDURES:

1. Install hydram to a drive head.
2. Accurately measure the drive head.
3. Attach and set an adjustable pressure relief valve and a pressure gauge to the discharge.
4. Start the hydram.
5. Open the snifter in order to fill the accumulator with air and then close the snifter for the duration of the experiment.
6. Calculate the impulse valve frequency.
7. Simultaneously measure the time of the experiment, water delivered (q) and water wasted (Q_w).
8. Calculate the efficiency (n).
9. Repeat the experiment making certain to keep the volume of air in the accumulator, drive head, delivery head, length of drive pipe, and frequency the same while changing the diameter of the drive pipe.

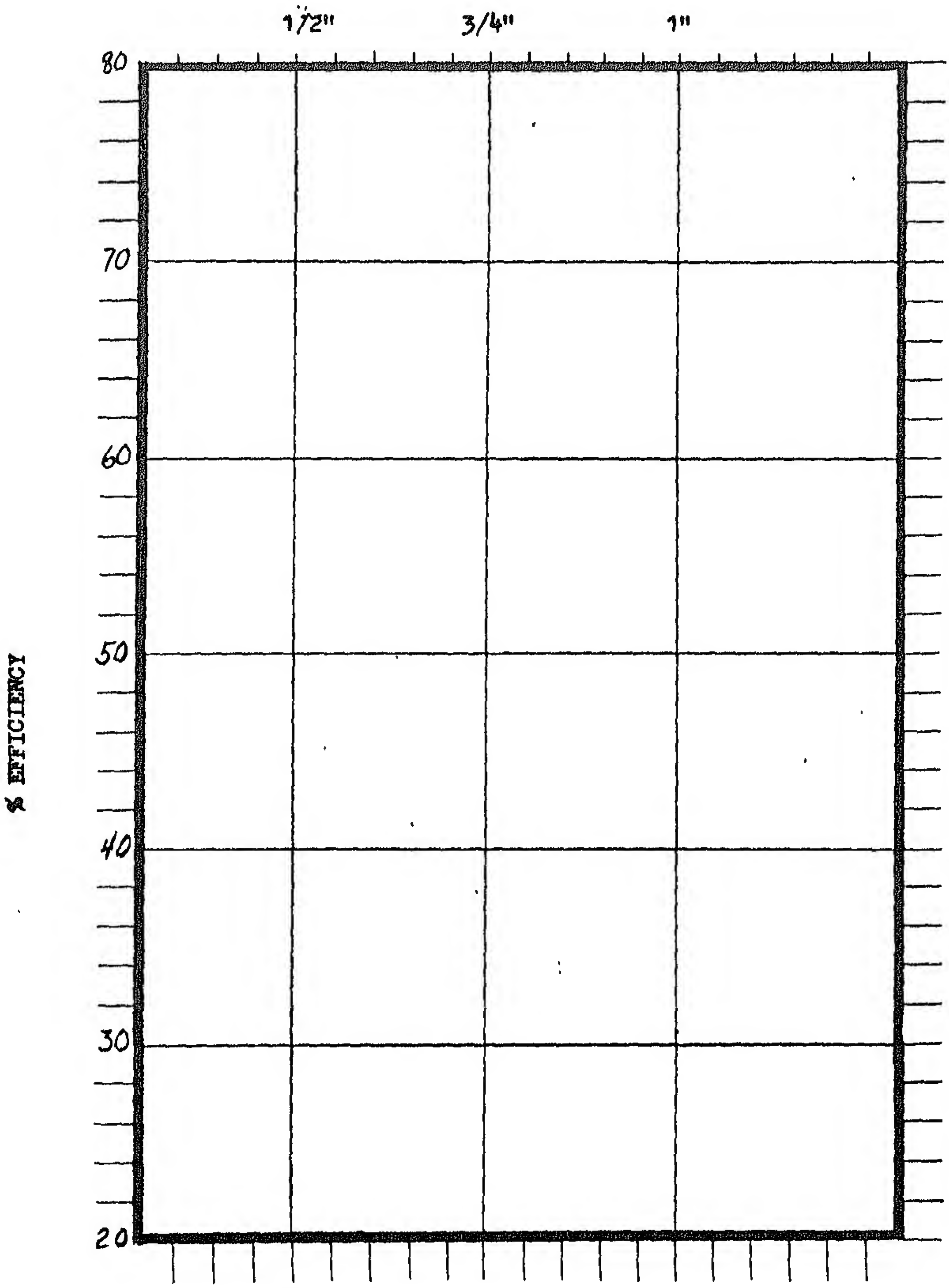
Exercise 6 - Part II

TASK: **Determine the effect of drive pipe diameter on efficiency**

Experiment #										
h:H ratio										
H										
h										
Qw										
q										
Q										
f										
s										
w										
t										
n										
Notes:										

Exercise 6 - Part III

EFFECT OF THE DRIVE PIPE DIAMETER ON EFFICIENCY



Exercise 7 - Part I

TASK: DETERMINE THE EFFECT OF THE SNIFTER ON EFFICIENCY

Variables: time of experiment, water wasted (Q_w), water used (Q), water delivered (q), efficiency

Controlled Variables: Snifter open, snifter closed, one way snifter

Constants: drive head (H), delivery head (h), volume of air in the accumulator

Range: sucking air and spitting water

PROCEDURES:

1. Install a hydram to a drive head.
2. Accurately measure the drive head.
3. Attach and set an adjustable pressure relief valve and a pressure gauge to the discharge.
4. Start the hydram.
5. Open the snifter in order to fill the accumulator with air.
6. Calculate the impulse valve frequency.
7. Simultaneously measure the time of the experiment, water delivered (q), and water wasted (Q_w).
8. Calculate the efficiency.
9. Repeat the experiment making certain to keep the volume of air in the accumulator, drive head (H), delivery head (h), and frequency the same while changing the snifter from an open snifter, a one way snifter to no snifter at all.

Exercise 7 - Part II

TASK: DETERMINE THE EFFECT SNIFTER HAS ON EFFICIENCY

Experiment #										
h:H ratio										
H										
h										
Qw										
q										
Q										
f										
s										
w										
t										
n										
Notes:										

Exercise 8 - Part I

TASK: DETERMINE THE EFFECT OF THE DRIVE MATERIAL ON EFFICIENCY

Variables: efficiency (n), water wasted (Q_w), water used (Q), water delivered (q), time of the experiment

Controlled Variables: volume of air in the accumulator, delivery head (H), frequency (f)

Constants: frequency (f), drive head (h), delivery head (h), volume of air in the accumulator

Range: 5:1, 10:1, 15:1, 20:1 for both steel and plastic pipes.

PROCEDURE:

1. Install a hydram to a drive head.
2. Accurately measure the drive head.
3. Attach and set an adjustable pressure relief valve and a pressure gauge to the discharge.
4. Start the hydram.
5. Open the snifter in order to fill the accumulator with air and then close the snifter for the duration of the experiment.
6. Calculate the impulse valve frequency.
7. Simultaneously measure the time of the experiment, water delivered (q) and water wasted (Q_w).
8. Calculate the efficiency (n).
9. Repeat the experiment making certain to keep the drive head frequency, volume of air in the accumulator, and drive pipe material the same until you have accurate efficiency calculations for h:H ratios of 5:1, 10:1, 15:1, 20:1.
10. Repeat the series of experiments after changing the drive pipe to a different material making certain that everything else stays the same.

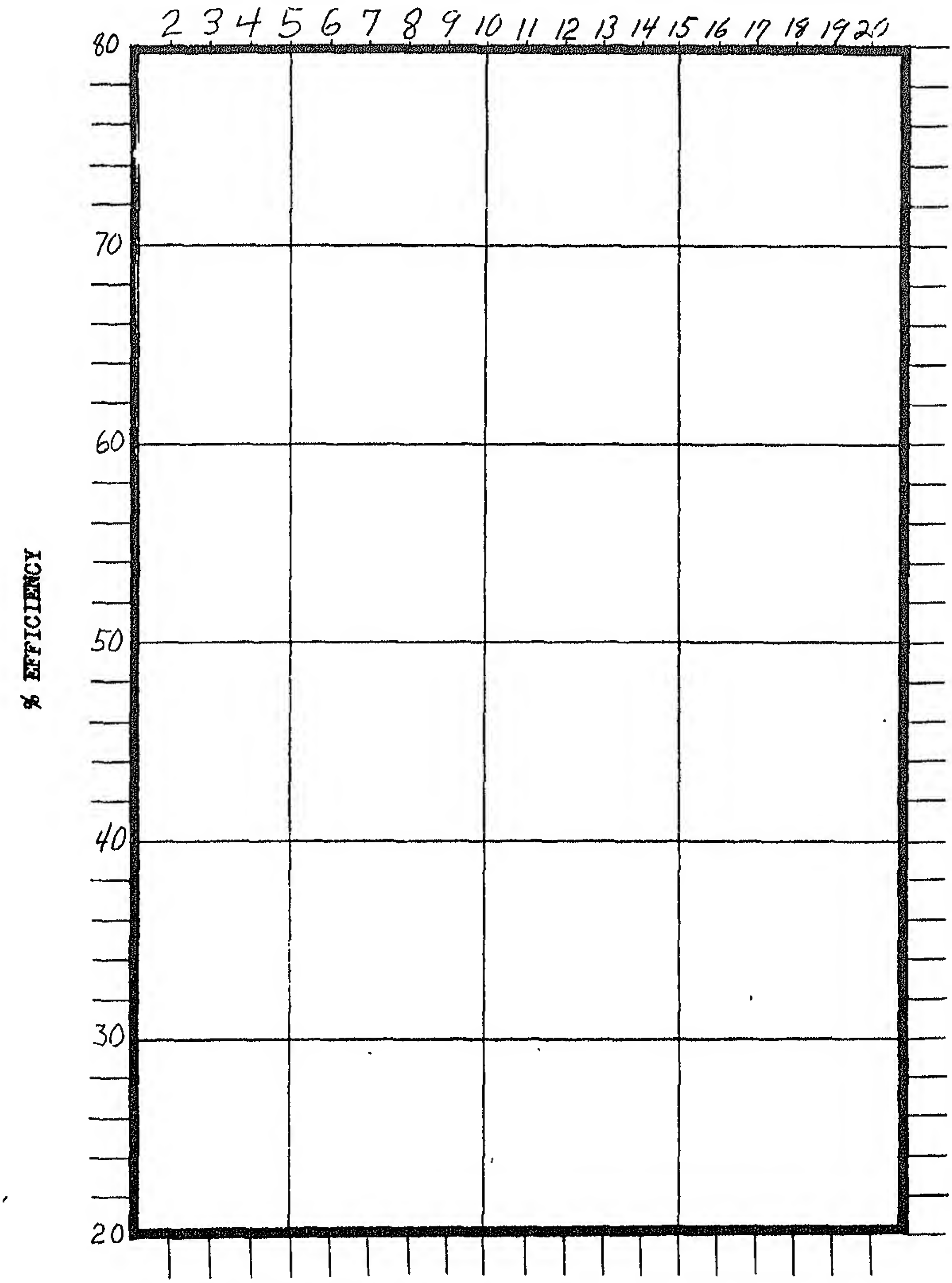
Exercise 8 - Part II

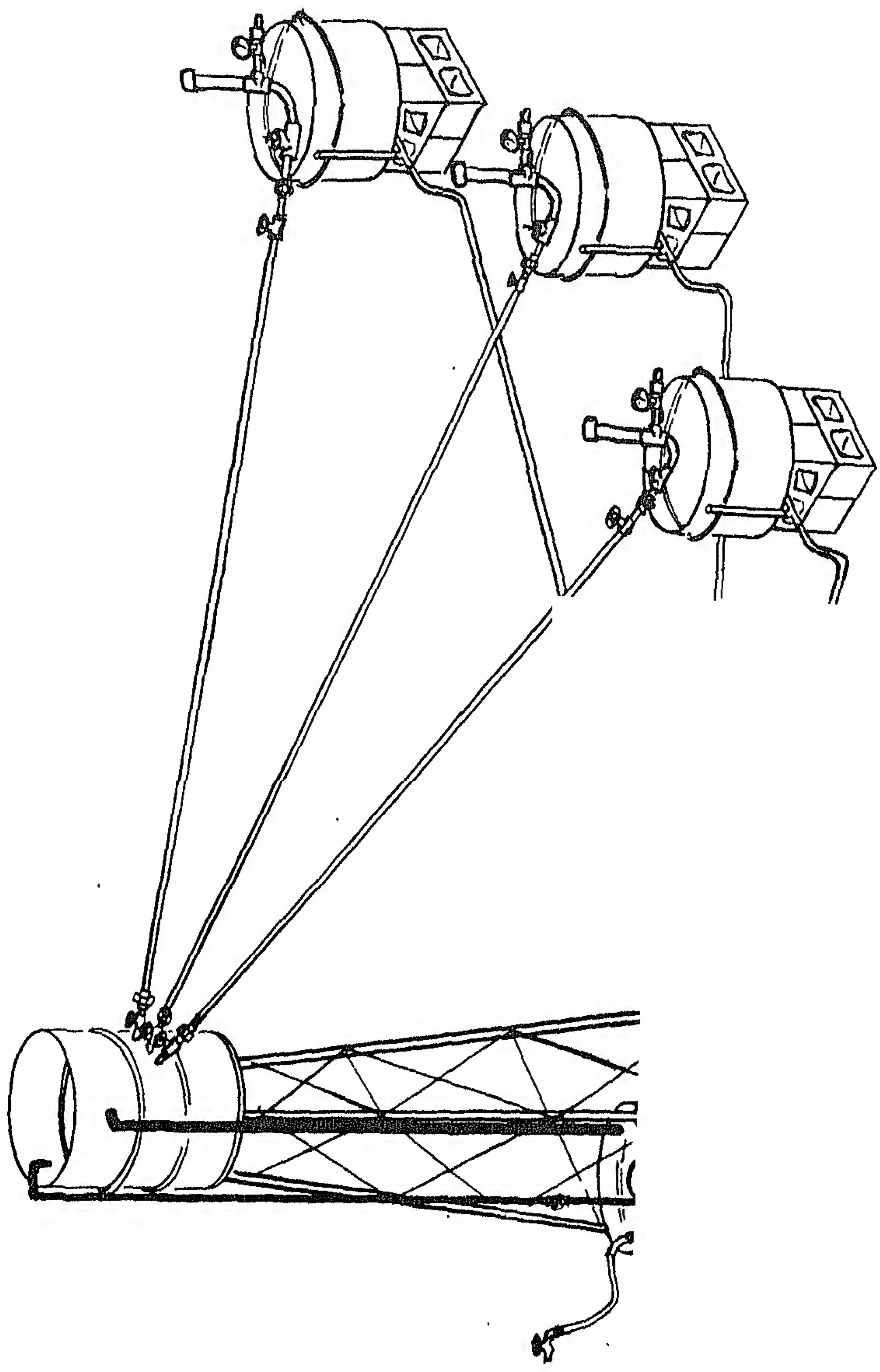
TASK: **Determine the effect of the drive pipe material on efficiency**

Experiment #										
h:H ratio										
H										
h										
Qw										
q										
Q										
r										
s										
w										
t										
n										
Notes:										

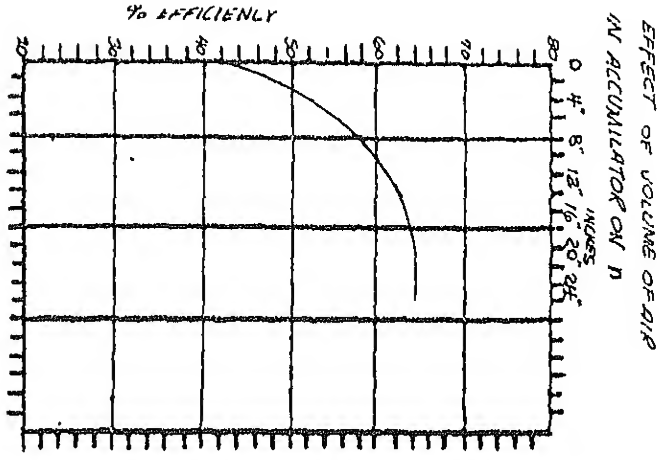
Exercise 8 - Part III

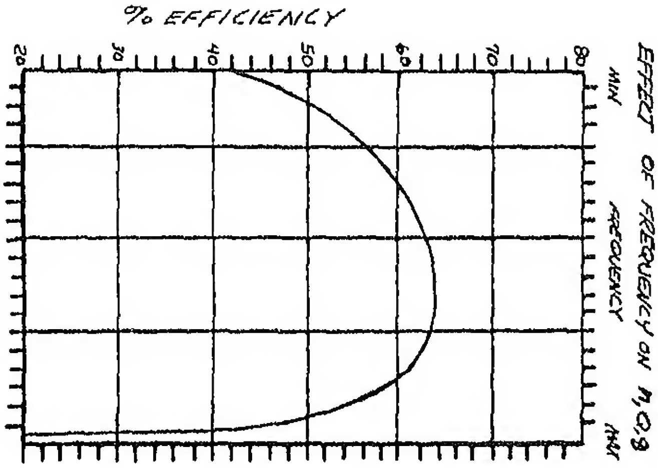
THE EFFECT OF THE DRIVE PIPE MATERIAL ON EFFICIENCY

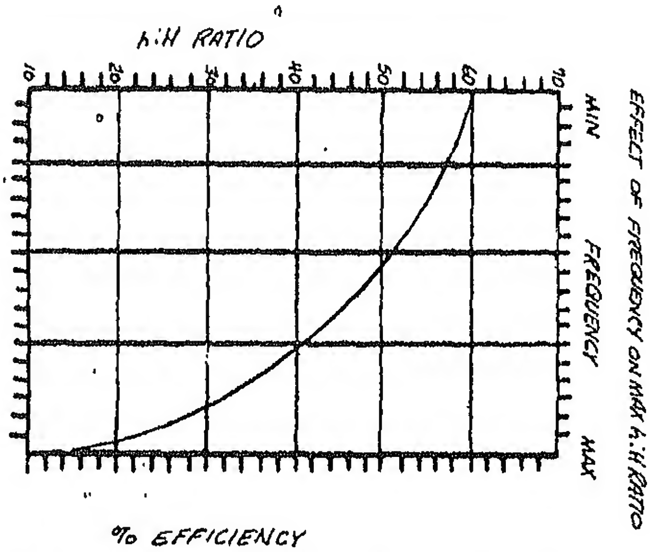


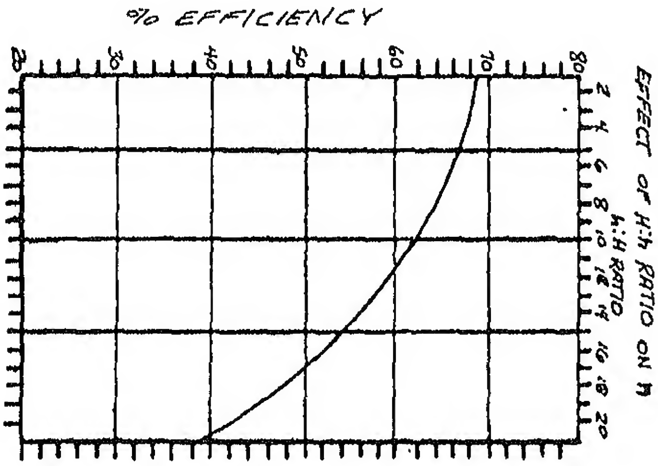


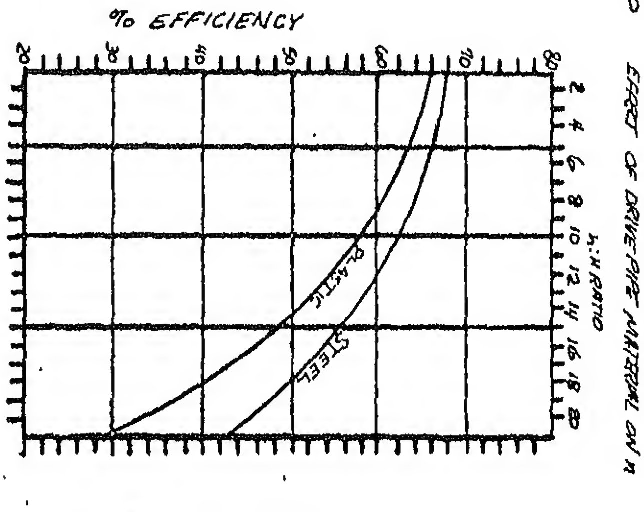
13 B
M EXPERIMENT SET-UP

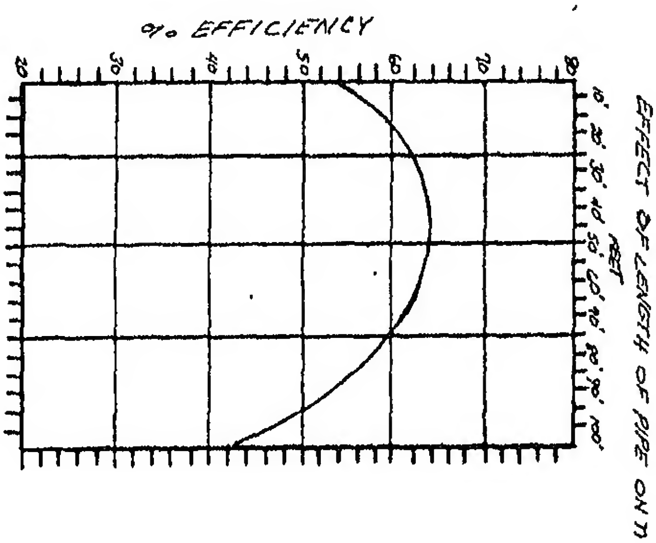


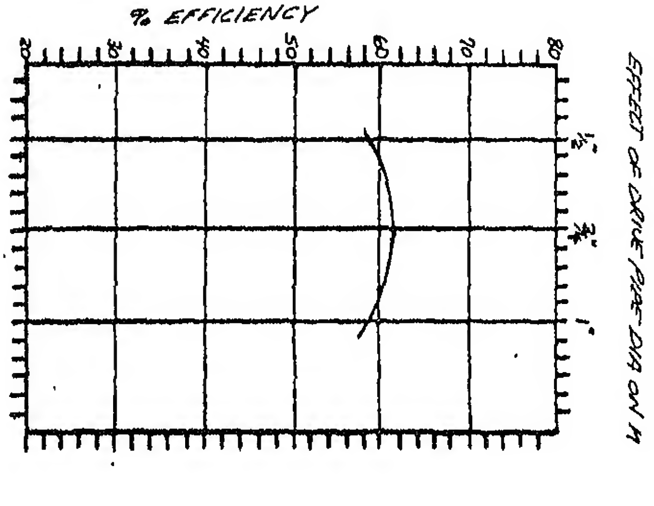












SAMPLE

GRAPHS

Handout 13 C

SESSION 14

SESSION 14: REPAIR AND MAINTENANCE   Time: 2-4 hours

OBJECTIVES: By the end of this session the trainees will be able to:

- predict malfunctions and problems in the operation of a hydram over time;
- accurately diagnose malfunctions and causes; and
- develop skills and experience in repair and maintenance of hydram systems.

OVERVIEW: Participants identify potential malfunctions, describe symptoms and prescribe cures; practice repairing; and develop strategy for long term preventive maintenance and routine service. The activity described below can be adapted for actual installations, if available.

MATERIALS: Handouts 14A (3 pp), 14B, 14C

TOOLS: All basic plumbing tools used to date in workshop

Spare parts

Enough hydrams for each experimental station

PROCEDURES	NOTES
1. State objectives of the session.	
2. Ask participants to generate a list of possible malfunctions and symptoms based on their construction experience, inter-relationship experiments, and what they've learned so far to date.	List should include all items on 14A, trainer should add any that are not mentioned.
3. Divide participants into 3 groups, and assign each group approximately 1/3 of the listed malfunctions. Distribute Handout 14B. <u>Group Task</u>: for each malfunction/symptom listed, complete columns 2 and 3 of handout 14B, and write on flip chart for presentation.	Alternatively, groups work on all symptoms, after groups finish, post flip charts on wall with each symptom. Individuals complete. Large group reviews, corrects, discusses. Trainers should be available if a group gets stuck. 1 hour.
4. Groups report out; check for accuracy and completeness of possible cures.	30 minutes.
5. Ask each group to select one malfunction, go to an experimental station, and simulate malfunction. Allow 20 minutes. Ask group to listen to the ram, write down the sound and record its deviation from a well functioning ram.	Trainers could also simulate to save time.
6. Each group moves to another station and listens to ram, records description of sound, diagnoses problem, determines solution and and repairs it.	
7. Each group will report on: - sound - diagnosis - success in repairing - implications for preventive maintenance.	
8. Repeat steps 5-7, this time groups to combine 2 malfunctions/symptoms.	

PROCEDURES - continued	NOTES
9. Ask participants to complete worksheet, Handout 14B, columns 4 and 5.	
10. In a large group, discuss implications for long term preventive maintenance. Have the group brainstorm a list of preventive maintenance tasks, routine servicing tasks. Individuals complete worksheet, handout 14C for their site.	Trainers will circulate to ensure that lists are complete, time frames accurate.

ATTACHMENT 14A

REPAIR AND-MAINTENANCE

SYMPTOM	CAUSE	REASON	CURE
impulse valve stops in the closed position	insufficient rebound	worn, cracked, or dirty check valve	clean, repair, or replace check valve
		insufficient weight or stroke on impulse valve	increase impulse valve stroke or weight
		insufficient flow of water into the drive pipe	check for leaks or obstructions in the supply system. If all the available water is going to the hayram, re-adjust the hydram for this flow
pulsating flow in the delivery pipe	lack of air in the accumulator	leak in the accumulator	repair leak
		snifter valve not open enough	open valve further
		clogged snifter valve	clean the snifter valve
reduction in water delivered and air bubbles in the delivery pipe	too much air entering the accumulator	snifter valve open too far	close down the snifter valve slightly
		leak in the hydram body between the impulse and check valves	repair the leak
impulse valve stops in the open position	insufficient velocity around the impulse valve	lack of water entering the drive pipe	check for leaks or obstructions in the supply system. If all available water is going to the hydram, re-adjust impulse valve for this flow rate.
		excessive impulse valve weight or stroke	Either shorten the stroke or lessen the weight.

ATTACHMENT 14 A

REPAIR AND MAINTENANCE

SYMPTOM	CAUSE	REASON	CURE
hydram won't start	insufficient back pressure	check valve not seating properly	clean, repair or replace check valve
		snifter valve open too far	close snifter until hydram starts
		insufficient water in the delivery pipe	continue to cycle hydram manually until sufficient delivery head is developed
	poor impulse valve seating	worn, cracked, dirty or misaligned valve	clean, repair, replace or align impulse valve
	lack of water entering the drive pipe	supply insufficient for hydram	re-assess installation, possibly install smaller hydram and/or drive pipe
		leaks or obstructions in supply system	clean or repair the supply system
	improper impulse valve stroke or weight	not adjusted correctly	either change stroke or weight
hydram runs but does not pump anything	obstructed delivery line	closed delivery valve	open the valve
		frozen delivery line	apply sufficient heat to thaw
		clogged delivery pipe.	clean out or back flush
	water hammer pressure pulse absorbed before the check valve	air accumulation under the check valve because of over-snifting	cycle the hydram several times by hand allowing the water to reach maximum velocity before allowing the impulse valve to close.

ATTACHMENT 14 A

REPAIR AND MAINTENANCE

SYMPTOM	CAUSE	REASON	CURE
hydram runs but the amount of water being delivered is much less than should be expected	leak in the delivery pipe	loose fitting or a hole in pipe	tighten all loose fittings and/or repair any holes
	low hydram efficiency	worn, cracked, dirty, or mis-aligned check valve	clean, repair or replace impulse valve
		worn, cracked, dirty or mis-aligned check valve	clean, repair or replace check valve
		obstruction in drive pipe	clean drive pipe
		excessive check valve stroke	adjust or replace check valve stroke limiter
	improperly installed hydram	poor L:D ratio	change either the drive pipe diameter or length
		poor L:H ratio	change either the drive pipe length or the drive head
frequency very erratic	air in the drive pipe	hole in the hydram body or a loose fitting near the drive pipe connection to the hydram	patch all holes and/or tighten all loose fittings

HANDOUT 14 B: REPAIR AND MAINTENANCE WORKSHEET

SYMPTON	CAUSE	CURE	TOOLS/SKILLS NEEDED FOR REPAIR	PREVENTIVE MAINTENANCE REQUIRED	TOOLS/SKILLS NEEDED FOR PREVENTIVE MAINTENANCE

HANDOUT 14 C- MAINTENANCE/SERVICE WORKSHEET

TASK	TIMEFRAME	WHO'S RESPONSIBLE	SKILLS/RESOURCES NEEDED

SECTION 15

SESSION 15: Review Exercise #2 Time: 2 hours

Objectives: By the end of this session trainees will have demonstrated their ability to:

- determine maximum drive and delivery heads for a given ram;
- describe key interrelationships in a hydram;
- accurately describe at least 5 factors affecting efficiency in a hypothetical ram installation.

Overview: Work to date in the three areas described above has been primarily group work. This activity provides the opportunity to apply this information individually, and clarify any misunderstandings.

Materials: Handout 15A

TRAINERS NOTE:

Specifications for problem #1 need to be provided, using the charts from Sessions 9 and 10. Alternatively, participants can take actual measurements from the pipefitting rams they constructed, and solve the problem for those rams.

Procedures	Notes
1. Explain purpose of session, resolve any hanging questions from previous session.	
2. Distribute handout, instructing participants to solve problems individually.	Allow 30 minutes for this.
3. Participants to compare answers in groups of 2-4, coming to agreed upon solution(s).	30 min.
4. For each problem, ask for volunteers and provide group answers. Check with other groups for variation/difference. Discuss rationale for answers, and/or differences.	45-one hour

REVIEW EXERCISE

1. What are the maximum recommended H & h in a 2" hydram where the impulse backing plate is ____ thick, the impulse seat area is ____, has ____ impulse valve bolts ____" in diameter, has a check valve backing plate ____" thick, and a check valve seat width of ____"?

Answer the following with a graph if you wish:

2. How does the amount of air in the accumulator effect "n"?

3. How does the h:H ratio effect "n"?

4. How does the frequency effect "Q_W"?

5. How does the snifter effect "q"?

6. Tomorrow you are going out to an existing hydram site where there is only 100 gpd being delivered, there is a reliable supply of 3 gpm and an h:H ratio of 10:1. The ram works consistently but the efficiency is so low that only ½ the water needed is being pumped. Do you feel 200 gpd can be pumped if the hydram and/or installation is corrected to improve the efficiency to a reasonable level? If yes, what are you going to look for as a possible reason for low efficiency? (At this point you know nothing else about the hydram or the manner in which it is installed) list as many factors as you can think of.

SESSION 16: Use of Multiple Rams Time: 1½ hours

Objective: By the end of this session trainees will describe how multiple rams, in series or parallel can be used in situations where h:H ratio, L:D ratio, or D make single ram unpractical or impossible.

Overview: In small groups, trainees will solve problems to determine that single ram is impossible, and describe and size multiple system for meeting water need. Large group will discuss advantages/disadvantages of these systems, including cost efficiency.

Materials: Handouts 16A, 16B, 16C, 16D
Problems 16A, 16B, 16C on flip chart
Flip charts, markers

SESSION 16